CA Water Plan Update 2013 - comments

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To: DWR CWP Comments
Attachments: DMS-#2764950-v1-ATH_Vol3_C~1.PDF (249 KB) ; DMS-#2759017-v2-Vol3_Ch20_~1.PDF (146 KB)

2nd of 2 e-mails

I am submitting comments today on behalf of the Sanitation Districts of Los Angeles County. I have compiled comments from our staff on various chapters, and, due to the size of some of the files, I will be e-mailing them in several different e-mail submittals.

I am also including the comments below on Chapter 25, Recharge Area Protection, instead of attaching a file with comments embedded.

Overall, the chapter is fine, the issue the authors need to be careful about is clarifying that recharge areas include both spreading grounds and injection wells.
Pg. 25-2, Line 8: Injection wells are used at locations where the cost to purchase large tracts of land for offstream spreading basins would be prohibitive, due to their smaller footprint, or when the soil or surface conditions do not allow for surface spreading.

Pg. 25-2, Line 14: Injection wells are expensive to build, but they may be more affordable than spreading basins in urban areas where land is very expensive due to their smaller footprint.

Pg. 25-3, Line 18: While the DWSAP requires assessment of **these issues**, amendments to the federal Clean Water Act do not require implementation of a protection program.

- It's unclear what "these issues" refers to.

Pg. 25-3, Line 29: Third, the dam was designed to release a smaller controlled amounts of water into the flood control channels and streams so that the water would not cause damage downstream. Nowadays these dams are also used to store excess water for release and use during the dry season.

Pg. 25-5, Line 21: **Many potentially contaminating activities** routinely have been allowed in recharge areas and contaminants have been carried into the aquifers.

- Some examples of these "potentially contaminating activities" should be listed.

Pg. 25-6, Line 19: If more recycled water is used for groundwater recharge, more recharge areas may be needed.

- This sentence should be worded better. Recommend the following: More recharge areas may be needed to fully utilize the state's available recycled water supply for groundwater recharge.

Pg. 25-7, Line 1: Potential Impacts - Protecting recharge areas can remove land from availability for other uses.

- More should be added here. Also, is this section meant to focus on just the negative impacts or all impacts negative and positive?

Pg. 25-7, Line 6: Increase State funding for proposals to identify and protect recharge areas including incentives or locating and for the proper destruction of abandoned water wells, monitoring wells, cathodic protection wells, and other wells that could become vertical conduits for contaminating the aquifer.

- This is the first time abandoned wells are mentioned as being a conduit for contamination. This should be mentioned earlier in the document.

Pg. 25-7, Line 14: Expand research into surface spreading as a means of groundwater recharge and the fate and transport of chemicals and microbes contained in the recharge water.

- This has already been done and is being done. [*See for instance, Final Report: An Investigation of Soil Aquifer Treatment for Sustainable Water Reuse, which can be found at http://www.watersmartproject.org/civica/filebank/blobdload.asp?BlobID=6309:]* Therefore, this is not needed as a recommendation.

Pg. 25-7, Line 42: Provide guidance and assistance for economic feasibility analyses that could be used by project planners and funding agencies to assess recharge areas as compared with long-term reduction of water supplies, wellhead treatment, **injection wells**, or conversion to other land uses.

- Injection wells are a type of recharge, so unsure how this is different than the "recharge areas" it's being compared to. Is "recharge area" meant to only apply to surface spreading recharge areas? If so, then parts throughout this whole chapter would need to be adjusted.
- This sentence may also be adjusted as follows: Provide guidance and assistance for economic feasibility analyses that could be used by project planners and funding agencies to assess different recharge options ~~areas~~ as compared with long-term reduction of water supplies, wellhead treatment, injection wells, surface spreading areas, or conversion to other land uses.

Table 25-1: Recharge Sites in California

- I do not think this table is all inclusive. The table is missing agencies with recharge areas in California. Also, it would be helpful to include the county for which these agencies' recharge sites are located.

Box 25-1: Terminology

- Abandoned Well – Some of this should be moved into the text of the document.
- Intentional recharge & Managed recharge – It's not clear what the difference is between the two.
- The last entry in this box should be moved to the text of the document. Also, revised as follows: (Line 15) These structures are called injection wells, recharge basins, spreading basins, or replenishment basins or areas.

If there are questions regarding any of our comments, please contact me and I will convey the questions to the correct staff. Please contact me or Denise Mays (djmays@lacsd.org) if there are problems with any of the attached files.

Thank you!

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Chapter 20. Urban Stormwater Runoff Management — Table of Contents

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Chapter 20. Urban Stormwater Runoff Management

Urban stormwater runoff management is a broad series of activities to manage both stormwater and dry-weather runoff. Dry-weather runoff occurs when, for example, excess landscape irrigation water flows to the storm drain. Traditionally, urban stormwater runoff management was viewed as a response to flood control concerns resulting from the effects of urbanization. Concerns about the water quality impacts of urban runoff have led water agencies to look at watershed approaches to control runoff and provide other benefits (see Box 20-1, "Objectives of Urban Stormwater Runoff Management"). As a result, urban stormwater runoff management is now linked to other resource management strategies, including pollution prevention (covered in Chapter 18 of this volume), land use planning and management (Chapter 24), watershed management (Chapter 27), urban water use efficiency (Chapter 3), municipal recycled water (Chapter 12), recharge area protection (Chapter 25), and conjunctive management and groundwater (Chapter 9).

PLACEHOLDER Box 20-1 Objectives of Urban Stormwater Runoff Management

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of this chapter.]

Urban Stormwater Runoff Management in California

The traditional approach to runoff management views urban runoff as a flood management problem in which water needs to be conveyed as quickly as possible from urban areas to waterways in order to protect public safety and property. Consequently, precipitation-induced runoff in urban areas has been viewed as waste, and not a resource.

Urbanization alters flow pathways, water storage, pollutant levels, rates of evaporation, groundwater recharge, surface runoff, the timing and extent of flooding, the sediment yield of rivers, and the suitability and viability of aquatic habitats. The traditional approach to managing urban and stormwater runoff has generally been successful at preventing flood damage, but it has several disadvantages. In order to convey water quickly, natural waterways are often straightened and lined with concrete, resulting in a loss of habitat and impacts on natural stream physical and biological processes. Urbanization creates impervious surfaces, meaning stormwater does not infiltrate into subsurface aquifers. These impervious surfaces collect pollutants that are washed off to surface waters when it rains. The impervious surfaces also increase runoff volumes and velocities, resulting in streambank erosion, and potential flooding problems downstream. Because of the emphasis on removing the water quickly, the opportunity to use storm-generated runoff for multiple benefits is reduced.

A watershed approach for urban stormwater runoff management tries to emulate and preserve the natural hydrologic cycle that is altered by urbanization. The watershed approach consists of a series of best management practices (BMPs) designed to reduce the pollutant loading and reduce the volumes and velocities of urban runoff discharged to surface waters. These BMPs may include facilities to capture, treat, and recharge groundwater with urban runoff; public education campaigns to inform the public about stormwater pollution, including the proper use and disposal of household chemicals; and technical assistance and stormwater pollution prevention training.

Methods for recharging groundwater with urban runoff include having roof runoff drain to vegetated areas; draining runoff from parking lots, driveways, and walkways into landscaped areas with permeable soils; using dry wells and permeable surfaces; and collecting and routing stormwater runoff to basins. Infiltration may require the use of source control and pretreatment before infiltration. Infiltration enables the soil to naturally filter many of the pollutants found in runoff and reduces the volume and pollutant load of the runoff that is discharged to surface waters. An example is the Elmer Avenue Neighborhood Retrofit Demonstration Project (see Box 20-2). The watershed approach will not prevent, nor should it prevent, all urban runoff from entering waterways. Elements of the traditional conveyance and storage strategy are still needed in order to protect downstream beneficial uses, protect water right holders, and protect the public from floods. In addition to infiltration of stormwater, other BMPs include the use of rain barrels and cisterns to “harvest” stormwater for later use (e.g., irrigation), and the use of structural controls that are designed to capture stormwater runoff and slowly release it into streams in order to mimic the natural hydrograph that existed before development occurred. In Los Angeles, the nonprofit TreePeople organization constructed a 216,000-gallon cistern in Coldwater Canyon Park to collect and store stormwater from building rooftops and parking lots for irrigation use during the dry months (see Box 20-3).

PLACEHOLDER Box 20-2 Elmer Avenue Neighborhood Retrofit Demonstration Project

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of this chapter.]

PLACEHOLDER Box 20-3 Stormwater Cistern, Coldwater Canyon Park, Los Angeles

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of this chapter.]

Urban stormwater runoff management has become more important and more controversial over the last two decades as municipal governments have been held increasingly responsible for pollutants washed from developed and developing areas within their jurisdictions into the storm sewer system and discharged into waterways. Unlike pollution from industrial and sewage treatment plants, pollutants in urban runoff and stormwater runoff come from many diffuse sources (see Box 20-4) and typically are not treated prior to being discharged to surface waters. As rainfall or snowmelt moves over the urban landscape, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and, potentially, groundwater. Pollution associated with discharges from a storm sewer system can occur outside of storms also, from landscape irrigation flows, improper disposal of trash or yard waste, illegal dumping, and leaky septic systems.

PLACEHOLDER Box 20-4 Examples of Pollution in the Urban Environment

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of this chapter.]

Runoff in the urban environment, both storm-generated and dry weather flows, has been shown to be a significant source of pollutants to the surface waters of the nation. As a result, the 1987 amendments to the federal Clean Water Act (CWA) required that discharges from municipal separate storm sewer systems serving a population of 100,000 or more must be in compliance with requirements contained in National Pollutant Discharge Elimination System (NPDES) permits. The U.S. Environmental Protection Agency (EPA) promulgated regulations for these discharges in 1990. These regulations were subsequently amended in 1999 to require that municipal separate storm sewer systems that served populations fewer than 100,000 and were located in an urbanized area were subject to requirements contained in an NPDES permit. In California, the authority to regulate urban and stormwater runoff under the NPDES system has been delegated by EPA to the State Water Resources Control Board (SWRCB) and the nine regional water quality control boards (RWQCBs).

Under the initial NPDES permits issued in the 1990s, municipalities were required to develop and implement a plan to reduce the discharge of pollutants into waterways, including the discharges from areas of new development and significant redevelopment. For the new development and redevelopment projects, the permit requirements were generally met by implementing BMPs that addressed discharges taking place during the construction activity but did not address discharges occurring after construction was completed (post-construction controls). Since the first municipal stormwater permits were adopted, and with continued beach closures and other pollution problems associated with urban runoff, it has become clear that post-construction controls, retrofit, and more advanced measures will be required in some areas to comply with water quality regulations (see Box 20-5).

PLACEHOLDER Box 20-5 Implementation Plan for Urban Stormwater Runoff Management Programs

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of this chapter.]

The SWRCB and RWQCBs seek opportunities for managing urban runoff that will result in multiple benefits. Low-impact development (LID) is one such collection of management techniques that has multiple benefits. LID is a sustainable practice that benefits water supply and contributes to water quality protection. Unlike traditional stormwater management, which collects and conveys stormwater runoff through storm drains, pipes, or other conveyances to a centralized stormwater facility, LID takes a different approach by using site design and stormwater management to maintain the site’s predevelopment runoff rates and volumes. The goal of LID is to mimic a site’s predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to the source of rainfall. LID has been a proven approach in other parts of the country and is seen in California as an alternative to conventional stormwater management. The SWRCB and RWQCBs are advancing LID in California in various ways.

LID can be used to benefit water quality, address the modifications to the hydrologic cycle, and be a means to augment local water supply through either infiltration or water harvesting. In light of this, the SWRCB and RWQCBs are incorporating the principals of LID into the permits now being issued and are funding projects that highlight LID using the various voter-approved bond funds.

The SWRCB and RWQCBs are also required under the federal CWA Section 303(d) and federal regulations (Code of Federal Regulations [CFR] Title 40, Section 130) to prepare a list of water bodies requiring total maximum daily loads (TMDLs) because they do not meet water quality standards and set priorities for these water bodies. The Section 303(d) list was last revised in 2010 and is currently being updated for 2012. Federal regulations require the Section 303(d) list to be updated every two years. TMDLs represent the total pollutant load a water body can assimilate before the water body’s beneficial uses are considered to be impaired and water quality standards are no longer met. Through the process of establishing the Section 303(d) list of impaired water bodies, it has often been found that urban runoff is a source of pollutants contributing to the impairment.

NPDES permits now issued to local agencies for discharges of stormwater require the implementation of specific measures to reduce the amount of pollutants in urban runoff. Permits for discharge to listed water bodies having a TMDL must be consistent with the waste load allocations in a TMDL. Under California law, TMDLs include implementation plans for meeting water quality standards. The implementation plans allow for time to implement control strategies to meet water quality standards.

Potential Benefits

The primary benefits of urban stormwater runoff management are to reduce surface water pollution and improve flood protection. Additional benefits may be to increase water supply through groundwater recharge in areas with suitable soil and geological conditions, and where pollution prevention programs are in place to minimize the impact on groundwater. Groundwater recharge and stormwater retention sites can also be designed to provide additional benefits to wildlife habitat, parks, and open space.

Underground facilities can store runoff and release it gradually to recharge a groundwater aquifer or release it to surface waters in a manner that mimics the natural hydrologic cycle. Captured stormwater can also be used as a source of irrigation water rather than using potable water. For instance, a school campus can solve its flooding problem and develop a new sports field at the same time. These may provide secondary benefits to the local economy by creating more desirable communities. By keeping runoff on a site, storm drain systems can be downsized, which could reduce the installation and maintenance costs of such systems. A watershed planning approach to managing urban runoff allows communities to pool economic resources and obtain broader benefits to water supply, flood control, water quality, open space, and the environment.

Statewide information on the benefits of increased management of urban runoff is not available, but examples from local efforts exist. The Fresno-Clovis metropolitan area has built an extensive network of stormwater retention basins that not only recharges more than 70 percent of the annual stormwater runoff (17,000 acre-feet [af]) and removes most conventional stormwater pollutants, but also recharges excess Sierra Nevada snowmelt during the late spring and summer (27,000 af). Los Angeles County recharges an average 210,000 af of storm runoff a year, which reduces the need for expensive imported water. Agencies in the Santa Ana watershed recharge about 78,000 af of local storm runoff a year. The ~~Los Angeles and San Gabriel Watershed~~ Council has estimated that if 80 percent of the rainfall that falls on just a quarter of the urban area within the watershed (15 percent of the total watershed) were captured and reused, total runoff would be reduced by about 30 percent. That translates into a new supply of 132,000 af of water per year or enough to supply 800,000 people for a year.

The City of Santa Monica is an example of a municipality that is taking a watershed approach to managing urban runoff. Santa Monica's primary goal is to treat and reuse all dry-weather flows. This turns a perceived waste product into a local water resource so that beach water quality is protected and the local nonpotable water supply is augmented. However, if dry-weather discharges are necessary, the city's secondary goal is to release only treated runoff into waterways. Both goals improve water quality of the

Santa Monica Bay. The city's goals promote development such that urbanization works with nature and the hydrologic cycle.

At the "lot" or home-owner level, LID techniques and practices can be used to reduce the amount of runoff being generated and slow its release to the storm sewer system or surface waters. Captured runoff can be harvested and stored for later use on-site. LID techniques and practices include rain barrels, cisterns, rain gardens, swales, trench drains, land grading, permeable pavers, tree-box filters, and green roofs. For further information, see Volume 3, Chapter 24, "Land Use Planning and Management." An analysis aimed at quantifying the benefits of LID techniques was conducted by the Natural Resources Defense Council and University of California, Santa Barbara (2009), and is summarized in Box 20-6; the full report is included in Volume 4.

PLACEHOLDER Box 20-6 Efforts to Quantify Benefits of Low-Impact Development

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of this chapter.]

Increase Local Water Supplies through Stormwater Capture

[NOTE: Plan to include subsection in future draft that discusses increasing water supplies through stormwater capture and use.].

Potential Costs

Information about statewide costs to implement urban stormwater runoff management activities is not available. The SWRCB contracted with the Office of Water Programs at California State University, Sacramento, to survey six communities to estimate the costs of complying with their NPDES stormwater permits (California State University, Sacramento, 2005). Although this may address the cost for a municipality to comply with specific programmatic elements of an NPDES permit, it may not be the most applicable for looking at watershed programs seeking multiple benefits.

The City of Santa Monica illustrates the costs of managing urban runoff from the perspective of treating dry-weather flows. The city has a stormwater utility fee that generates about $1.2 million annually and has been in place since 1995. The funds are used for various programs to reduce or treat runoff. They go to the city's urban runoff management coordinator for the maintenance of the storm drain system and to help support other city staff that conduct runoff work. Additional funds are spent by other divisions to perform runoff management efforts, such as street sweeping, some trash collection, sidewalk cleaning, and purchasing and maintaining equipment. The city has also received five grants totaling more than $3.5 million for the installation of structural BMP systems, all of which will require long-term maintenance and monitoring by the city. The culmination of the city's program is the $12 million Santa Monica Urban Runoff Recycling Facility (SMURRF), a joint project of the City of Santa Monica and the City of Los Angeles. The SMURRF project is a state-of-the-art facility that treats dry-weather runoff water before it reaches Santa Monica Bay. Up to 500,000 gallons per day of urban runoff generated in parts of the cities of Santa Monica and Los Angeles can be treated by conventional and advanced treatment systems at the SMURRF.

Major Implementation Issues

Lack of Integration with Other Resource Management Strategies

Land use planning is not conducted on a watershed basis. Many agencies spend millions of dollars annually addressing urban runoff problems with very little interagency coordination (both within the municipality and with other neighboring municipalities) even though downstream communities can be affected by activities upstream. In other words, internal communications within local government can be improved to ensure that the program goals and direction of one branch do not conflict with those of another; and local governments need to communicate with one another to ensure that land use planning on a regional level is complementary across jurisdictional boundaries.

Solutions to managing urban runoff are closely tied to many interrelated resource management strategies, including land use planning, watershed planning, water use efficiency, recycled water, protecting recharge areas, and conjunctive management. How and why water is used in the urban environment needs to be considered comprehensively within a watershed.

Climate Change

Climate change models project more frequent flood-producing storm events. These storms may overwhelm existing urban stormwater infrastructure, resulting in more localized flooding. During drought periods, additional landscape irrigation could create higher levels of runoff. In addition, contaminant buildup during extended dry conditions could result in increased impacts on coastal areas when large storms flush those contaminants out to coastal water bodies or the ocean.

Adaptation

Urban planning and development that incorporates opportunities to capture and infiltrate rainwater will assist cities in adapting to higher-precipitation storm events. Landscape design elements such as xeriscaping, drought-tolerant gardens, and bioswales can improve water capture and infiltration. Minimizing impervious areas, using regionally appropriate landscaping features, and seeking opportunities for harvesting rainwater for on-site use or infiltrating rainfall into ground water aquifers in new development will help protect against flooding from stronger storms.

Mitigation

Harvesting rainwater at the site level and infiltrating it on a regional scale can result in reducing localized flooding, as well as increasing local water supply through groundwater recharge. Harvesting when combined with the use of regionally appropriate landscaping can also reduce the amount of water needed to be delivered to the home for landscape irrigation. These activities can reduce the demand for energy-intensive water supplies, thus reducing the amount of greenhouse gas emissions produced from urban water supply.

Lack of Funding

The two main aspects of implementing urban stormwater runoff management measures are source control, including education, and structural controls. In highly urbanized areas, major costs for structural controls include purchasing land for facilities and constructing, operating, and maintaining treatment facilities. Local municipalities have limited ability to pay for retrofitting existing developed areas within existing budgets. The provisions of Proposition 218 have limited local municipalities' ability to increase fees to pay for services required to implement robust urban stormwater runoff management programs. Additional information on Proposition 218 is available in Volume 4.

Effects of Urban Runoff on Groundwater Quality

The movement of pollutants in urban runoff is a concern. Urban runoff contains chemical constituents and pathogenic indicator organisms that could impair water quality. Studies by the EPA (U.S. Environmental Protection Agency 1983) and the U.S. Geological Survey (Schroeder 1993) indicate that all monitored pollutants stayed within the top 16 centimeters of the soil in the recharge basins. The actual threat to groundwater quality from recharging urban runoff depends on several factors, including soil type, source control, pretreatment, solubility of pollutants, maintenance of recharge basins, current and past land use, depth to groundwater, and the method of infiltration used.

Nuisance Problems/Other Concerns

The presence of standing water in recharge basins and other drainage and storage structures can lead to vector problems, such as mosquitoes and the transmission of West Nile virus. The California Department of Public Health has developed guidelines that address the issue of vector control in basins. These same concerns also apply to the on-site capture of runoff for later use.

A number of state agencies are encouraging infiltration and have found it to be an effective means of dealing with surface water pollution and the excess volumes and velocities of runoff created in the urban environment. However, it is also acknowledged that infiltration is not appropriate in all circumstances. Examples of this would be the widespread use of infiltration in a brownfield development or infiltrating large amounts of water in hillside developments where slope stability may be an issue.

Protecting Recharge Areas

Local land use plans often do not recognize and protect groundwater recharge and discharge areas. Areas with soil and geologic conditions that allow groundwater recharge should be protected where appropriate. If development does occur in these areas, the amount of impervious cover should be minimized, and infiltration of stormwater should be encouraged on both a regional scale as well as at the "lot" level. In 2010, the Los Angeles and San Gabriel Rivers Watershed Council (now known as the Council for Watershed Health) prepared a water augmentation study that looked at the results of stormwater infiltration and the impact on groundwater (Los Angeles and San Gabriel Rivers Watershed Council 2010). Refer to Volume 3, Chapter 25, "Recharge Area Protection," for additional information.

Misperceptions

There are many misperceptions about urban runoff and its management. Urbanization changes the native landscape and creates many sources of urban runoff pollution. Urbanization brings about increases in impervious surfaces that do not allow precipitation to infiltrate into the ground, causing increased runoff volume and velocity that changes streams to become more "flashy." In addition, the traditional way that the urban environment has been landscaped (lawns) has called for the use of lawn care products to keep lawns green and free from weeds and other unwanted vegetation. The use of lawn care products creates a pollutant source when excess watering washes products off and into the storm sewer system. Likewise, the transportation system creates sources of runoff pollution.

Storm sewer systems have been designed to carry water away from the urban environment in order to reduce localized flooding during storm events. The systems have worked well in this regard, which has led to the public often times viewing runoff as a waste. However, with increasing demands on a limited water supply (surface water and groundwater) and climate-induced changes in precipitation patterns, water that otherwise would run off and be discharged to surface waters is being viewed as a resource. Changes in how new developments are planned and built, and changes in how we manage the existing urbanized areas, can create opportunities to capture runoff for future use.

Existing Codes

There are current codes and ordinances within State and local government that could conflict with some of the goals of managing urban runoff. Dry-weather flows have been shown to be significant sources of pollution, with one of the primary dry-weather flows being runoff associated with landscape irrigation and lawn watering. Reduction/elimination of these flows not only provides a water quality benefit, but also reduces the amount of potable water that is being used in a community. However, some municipalities have "green lawn" ordinances, and compliance oftentimes leads to runoff. Other codes require minimum street widths that can inhibit the minimization of impervious surfaces.

Recommendations

State

State agencies should:

1. Coordinate their efforts to decide how urban stormwater runoff management should be integrated into their work plans.
2. Coordinate their efforts to develop a single message to the public and local government regarding managing urban runoff through the use of low-impact development (LID) techniques.
3. Coordinate their efforts to develop appropriate site design requirements that can be incorporated into either local building codes or statewide building standards.
4. Lead by example by incorporating LID into projects to showcase the use, utility, and cost of the features. Site design should be given the same attention that indoor environmental quality, energy usage, etc., are given in the design, funding, and construction of public projects.
5. Encourage public outreach and education about the benefits and concerns related to funding and implementation of urban runoff measures.
6. Provide leadership in the integration of water management activities by assisting, guiding, and modeling watershed and urban runoff projects.
7. Work with local government agencies to evaluate and develop ways to improve existing codes and ordinances that currently stand as barriers to implementing and funding urban stormwater runoff management.
8. Provide funding and develop legislation to: support development of urban runoff and watershed management plans; enable local agencies and organizations to pursue joint-venture, multipurpose projects; and collect information on regional urban stormwater runoff management efforts.
9. Assist agencies with developing recharge programs with appropriate measures to protect human health, the environment, and groundwater quality.
10. Work with federal policymakers and industry to create research and development incentives and to develop standards to reduce urban runoff from transportation-related sources, including lubricant systems, cooling systems, brake systems, tires, and coatings.

11. Maintain a publicly accessible clearinghouse of information regarding practices that can be used to address water quality issues associated with urban stormwater runoff management.
12. Work with local government to seek legislative solutions to the limitations imposed by Proposition 218.

Local Agencies and Governments

Local agencies and governments should:

13. Design recharge basins to minimize physical, chemical, or biological clogging; periodically excavate recharge basins when needed to maintain infiltration capacity; develop a groundwater management plan with objectives for protecting both the available quantity and quality of groundwater; and cooperate with vector control agencies to ensure the proper mosquito control mechanisms and maintenance practices are being followed.
14. Seek opportunities to include LID techniques in public works projects.
15. Work with the development community to identify opportunities to address urban stormwater runoff management, including LID, in development and redevelopment projects.
16. Develop urban stormwater runoff management plans, integrating the following practices into the development process:
    A. Understand how land use affects urban runoff.
    B. Communicate with other municipalities regarding how land use will change the hydrologic regime on a regional basis and how this change is being addressed.
    C. Look for opportunities to require features that conserve, clean up, and reduce urban runoff in new development and in more established areas when redevelopment is proposed.
    D. Be aware of technological advances in products and programs through communications with other municipalities, branches of local government, and professional organizations.
    E. Learn about urban runoff and watershed ordinances already in place. For example, the City of Santa Monica and the Fresno Metropolitan Flood Control District already have extensive urban stormwater runoff management programs in place.
    F. Integrate urban stormwater runoff management with other resource management strategies covered in this volume, including pollution prevention, land use planning and management, watershed management, urban water use efficiency, municipal recycled water, recharge area protection, and conjunctive management and coordinate both within and across municipal boundaries.
    G. Be sensitive to the fact there are going to be sites where it is not appropriate to infiltrate urban runoff and stormwater flows.
    H. Integrate urban stormwater runoff management with development goals and strategies in the community.
17. Communicate with citizens about pollution of urban runoff and what can be done about it.
18. Create lists of locally accepted practices that could be used at the homeowner level to address urban runoff.
19. Review codes and ordinances to determine whether there are impediments to managing urban runoff and amend these as needed or as is appropriate.
20. Coordinate urban stormwater runoff management with local water purveyors to ensure the goals and activities of each complement each other rather than conflict.
21. Seek opportunities to provide incentives for the installation of LID features at the lot level for new and existing developments.

Urban Stormwater Runoff Management in the Water Plan

[This is a new heading for Update 2013. If necessary, this section will discuss the ways the resource management strategy is treated in this chapter, in the regional reports, and in the sustainability indicators. If the three mentions aren't consistent, the reason for the conflict will be discussed (e.g., the regional reports are emphasizing a different aspect of the strategy). If the three mentions are consistent with each other (or if the strategy isn't discussed in the rest of Update 2013), there is no need for this section to appear.]

References

References Cited

California State University, Sacramento, Office of Water Programs. 2005. *NPDES Stormwater Cost Survey: Final Report*. Sacramento (CA): California State University, Sacramento. 296 pp. Contract 02-189-250-0. Prepared for: State Water Resources Control Board. Viewed online at: http://www.owp.csus.edu/research/npdes/costsurvey.pdf. Accessed: Oct. 29, 2012.

Los Angeles and San Gabriel Rivers Watershed Council. 2010. *Water Augmentation Study: Research, Strategy, and Implementation Report*. Los Angeles (CA): Los Angeles and San Gabriel Rivers Watershed Council. 75 p. Viewed online at: http://watershedhealth.org/Files/document/522_WAS_StrategyDocument_web.pdf. Accessed: Nov. 1, 2012.

National Resources Defense Council and University of California, Santa Barbara. 2009. *A Clear Blue Future: How Greening California Cities Can Address Water Resources and Climate Challenges in the 21st Century*. New York (NY): National Resources Defense Council. 53 pp. Technical report. Viewed online at: http://www.nrdc.org/water/lid/files/lid.pdf. Accessed: Oct. 29, 2012.

Schroeder RA. 1993. *Potential for Chemical Transport Beneath a Storm-Runoff Recharge (Retention) Basin for an Industrial Catchment in Fresno, California*. Sacramento (CA): U.S. Geological Survey. 38 pp. Water-Resources Investigations report No. 93-4140.

TreePeople. 2012a. "Collect the Rainwater." Beverly Hills (CA): TreePeople. [Web page.] Viewed online at: http://www.treepeople.org/collect-rainwater. Accessed: Oct. 29, 2012.

TreePeople. 2012b. "Cistern." Beverly Hills (CA): TreePeople. [Web page.] Viewed online at: http://www.treepeople.org/cistern. Accessed: Oct. 29, 2012.

U.S. Environmental Protection Agency, Water Planning Division. 1983. *Results of the Nationwide Urban Runoff Program: Volume 1 — Final Report*. Washington (DC): U.S. Environmental Protection Agency. 198 pp. EPA No. 832R83112. Viewed online at: http://www.epa.gov/npdes/pubs/sw_nurp_vol_1_finalreport.pdf. Accessed: Oct. 29, 2012.

Additional References

Dallman S, Piechota T. 1999. *Stormwater: Asset Not Liability*. Los Angeles (CA): Los Angeles and San Gabriel Rivers Watershed Council. 41 pp. Funded by: U. S. Environmental Protection Agency Region 9 and the Union Bank of California. Viewed online at: http://www.lasgrwc.org/publications/Stormwater.pdf. Accessed: Oct. 29, 2012.

Kayhanian M, Johnston J, Yamaguchi H, Borroum S. 2001. "Caltrans Storm Water Management Program." Stormwater 2(2). [Journal.] Viewed online at: http://www.stormh2o.com/SW/Articles/3273.aspx. Accessed: Oct. 29, 2012.

Lehner P, George P, Aponte C, Cameron DM, Frank AG. 2001. *Stormwater Strategies: Community Responses to Runoff Pollution*. Chapter on low-impact development added in October 2001; report originally published in 1999. San Francisco (CA): Natural Resources Defense Council. Viewed online at: http://www.nrdc.org/water/pollution/storm/stoinx.asp. Accessed: Oct. 29, 2012.

LowImpact Development Center. 2007. *A Review of Low-Impact Development Policies: Removing Institutional Barriers to Adoption*. Sacramento (CA): State Water Resources Control Board Stormwater Program and the Water Board Academy. 27 pp. Project officer: Greg Gearheart, professional engineer.

Pitt R, Clark S, Parmer K. 1994. *Potential Groundwater Contamination from Intentional and Nonintentional Stormwater Infiltration*. Project Summary. Cincinnati (OH): U.S. Environmental Protection Agency, Risk Reduction Engineering Laboratory, Office of Research and Development. 7 pp. EPA/600/SR-94/051. Viewed online at: http://purl.access.gpo.gov/GPO/LPS35032. Accessed: Oct. 29, 2012.

Santa Ana Watershed Project Authority, Planning Department. 2005. *Santa Ana Integrated Watershed Plan 2005 Update*. Riverside (CA): Santa Ana Watershed Project Authority. 183 pp.

City of Santa Monica Urban Watershed Management Program. 2005. *Working for a Cleaner Bay*. Santa Monica (CA): City of Santa Monica. 16 pp. Viewed online at: http://www.swrcb.ca.gov/water_issues/programs/climate/docs/resources/sm_2005runoffbrochure.pdf. Accessed: Oct. 29, 2012.

City of Santa Monica Office of Sustainability and the Environment. 2009. *Stormwater Best Management Practices for New Developments, Major Retrofits and Tenant Improvements: A Stormwater Design Primer for Developers, Architects and Builders*. Santa Monica (CA): City of Santa Monica. 2 pp. [Pamphlet.] Viewed online at: http://www.swrcb.ca.gov/water_issues/programs/climate/docs/resources/sm_bmpbrochurejan09.pdf. Accessed: Oct. 29, 2012.

State Water Resources Control Board, California Coastal Commission, and Nonpoint Source Interagency Coordinating Committee. 2003. *State of California Nonpoint Source Program Five-Year Implementation Plan: July 2003 Through June 2008*. Sacramento (CA): State Water Resources Control Board. 423 pp. Viewed online at:

http://www.waterboards.ca.gov/water_issues/programs/nps/docs/5yrplan/nps5yrplan_20032008.pdf. Accessed: Oct. 29, 2012.

Box 20-1 Objectives of Urban Stormwater Runoff Management

- Protection and restoration of surface waters by minimizing pollutant loadings and negative impacts resulting from urbanization.
- Protection of environmental quality and social well-being.
- Protection of natural resources (e.g., wetlands and other important aquatic and terrestrial ecosystems).
- Minimization of soil erosion and sedimentation problems.
- Maintenance of predevelopment hydrologic conditions.
- Protection and augmentation of groundwater supplies.
- Control and management of runoff to reduce or prevent flooding.
- Management of aquatic and riparian resources for active and passive pollution control.

Box 20-2 Elmer Avenue Neighborhood Retrofit Demonstration Project

The Elmer Avenue Neighborhood Retrofit Demonstration Project is part of the Los Angeles Basin Water Augmentation Study, led by the Council for Watershed Health (formerly the Los Angeles and San Gabriel Rivers Watershed Council) and including multiple stakeholders. The project was designed to capture and infiltrate the runoff generated by a 0.75-inch design storm within the 40-acre residential catchment that fed surface flow to the 5800 block of Elmer Avenue. This block is a residential area with 24 single-family homes, located in the San Fernando Valley, that was susceptible to floods due to the absence of storm drains and sidewalks. The project improves drainage and groundwater recharge and provides stormwater quality mitigation through the application of multiple low-impact development strategies on both public and private lands (Los Angeles and San Gabriel Rivers Watershed Council 2010).

A wide range of integrated management strategies and practices are part of the demonstration, from individual rain barrels (cisterns) on single-family homes to wide-scale infiltration trenches that were constructed underground along roadways. All of the systems are a focus of an extensive monitoring program under way that provides knowledge about the physical and social effectiveness of the installed systems.

The project was designed to provide 16 acre-feet (af) of groundwater recharge annually. Measurements and estimates suggest that in 2010-2012 the systems infiltrated about 40 af over the two years, exceeding the groundwater recharge design goal. Two large infiltration systems are under the roadway and handle the bulk of the recharge. Bio-swales are used to capture flow from the residential parcels. The project included retrofits to individual homes, with features such as porous pavement, rain barrels, native planting, and rain gardens.

PLACEHOLDER Photo A Elmer Avenue Infiltration Galleries Before They Were Buried under the Street

[Any draft photos available for the public review draft appear after this box.]

PLACEHOLDER Photo B Depressed Swale Mini-Creek Bed Center, Complete with Drought-Resistant Native Landscaping (sidewalk left, curb right)

[Any draft photos available for the public review draft appear after this box.]

PLACEHOLDER Photo C Elmer Avenue Curbside Bio-Swale Filled by Half-Inch Rainstorm

[Any draft photos available for the public review draft appear after this box.]

Photo A Elmer Avenue Infiltration Galleries Before They Were Buried under the Street

[photo to come]

Photo B Depressed Swale Mini-Creek Bed Center, Complete with Drought-Resistant Native Landscaping (sidewalk left, curb right)

[photo to come]

Photo C Elmer Avenue Curbside Bio-Swale Filled by Half-Inch Rainstorm

[photo to come]

Box 20-3 Stormwater Cistern, Coldwater Canyon Park, Los Angeles

In an effort to reduce demand for imported water supplies and cost, the nonprofit organization TreePeople designed and constructed a 216,000-gallon cistern, underground stormwater storage tank, in Coldwater Canyon Park in Los Angeles. This innovative runoff management strategy captures and stores stormwater runoff to use on-site for irrigation during the dry months. The installation includes a stormwater storage and collection system to capture stormwater that falls on nearby building rooftops and a parking lot. Stormwater that falls onto the parking lot flows into a centralized gravel trench drain, which filters it. The water then seeps into pipes and is carried to the cistern. The buildings are also fitted with rain barrels in order to provide additional storage for rainwater. These barrels can be used to water urban watershed gardens that help allow for more infiltration of water on-site (TreePeople 2012b).

In 2010, the TreePeople facility captured more than 70,000 gallons from a three-day Los Angeles storm. A TreePeople Web page (TreePeople 2012a) states, “This solution prevents local flooding, helps keep beaches clean and if implemented widely, could stimulate the economy. … Last year, despite the declared drought emergency, TreePeople’s cistern captured enough rainwater to meet most of Coldwater Canyon Park’s irrigation needs, greatly minimizing the nonprofit’s dependency on the L.A. City water grid.”

PLACEHOLDER Photo A TreePeople’s 216,000-Gallon Cistern Under Construction

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PLACEHOLDER Photo B TreePeople’s Parking Lot with Storm Drains Piped to Cistern

[Any draft figures or photos that accompany this text for the public review draft will follow this box.]

Photo A TreePeople's 216,000-Gallon Cistern Under Construction

[photo to come]

Photo B TreePeople's Parking Lot with Storm Drains Piped to Cistern

[photo to come]

Box 20-4 Examples of Pollution in the Urban Environment

- Herbicides and pesticides from landscaped areas (residential and commercial), golf courses, city parks, etc.
- Oil, grease, and heavy metals from normal vehicle use (automobiles, trucks, and buses) that accumulate on streets, roads, highways, driveways, and parking lots (leaks and drips, brake pad dust, tire wear, etc.).
- Sediment from improperly managed construction activities.
- Litter and green waste.
- Bacteria from improperly maintained septic systems, encampments, and waste from pets and wildlife.
- Nutrients from the application of excess fertilizers on landscaped areas (home, commercial, parks, etc.).
- Illegal dumping of material into the storm sewer system (used crankcase oil, antifreeze, pesticide container rinse water, etc.).
- Atmospheric deposition.
- Natural catastrophes.
- Building maintenance (pressure washing of lead-based paints, rinsing of walkways, etc.).
- Sanitary sewer overflows.
- Illegal cross connections with the sanitary sewer systems.

Box 20-5 Implementation Plan for Urban Stormwater Runoff Management Programs

Implementation of urban stormwater runoff management programs will require local agencies to:

- Promote coordination of interagency programs that protect water quality from urban runoff pollution.
- Reduce the potential for contamination of surface water and groundwater that results from uncontrolled or poorly controlled urban runoff practices.
- Develop tools to assess the effectiveness of urban water pollution programs.
- Increase the availability of regulatory and guidance documents and instructional workshops to demonstrate effective urban runoff pollution control programs and policies.
- Reduce the number of uncontrolled urban runoff pollution sources by increasing the number of municipalities, industries, and construction sites that use non-point source management measures and fit under the permitted State Storm Water Program.
- Develop and implement watershed-based plans, including total maximum daily loads and stormwater management programs in order to identify and address impacts from urban land use.

Box 20-6 Efforts to Quantify Benefits of Low-Impact Development

Low-impact development (LID) practices that emphasize infiltrating stormwater to recharge groundwater supplies or capturing rooftop runoff in rain barrels and cisterns for on-site use can be used to increase access to safe and reliable sources of water for end users, while reducing the amount of energy consumed and the greenhouse gas (GHG) emissions generated by supplying the water. Analysis by the Natural Resources Defense Council and University of California, Santa Barbara (2009) demonstrates that implementing LID practices at commercial and residential development and redevelopment, in urbanized Southern California and limited portions of the San Francisco Bay area, has the potential to increase water supplies by 229,000-405,000 acre-feet (af) per year by 2030. The water savings at these locations translate into electricity savings of 573,000-1,225,500 megawatt-hours (MWh), avoiding the release of 250,500-535,000 metric tons of carbon dioxide per year, as the increase in energy-efficient local water supply from LID results in a decrease in need to obtain water from energy-intensive imported sources of water, such as the State Water Project or energy-intensive processes such as ocean desalination.

The study analyzed geographic-information-system-based land use data, water supply patterns, and the energy consumption of water systems in California in order to estimate the water supply, energy use, and GHG emissions benefits of LID on a regional basis, under a conservative set of assumptions. The ranges presented for each benefit reflected a set of variables and input values used to create low and high estimates of potential savings. The study considered the percentage of impervious surface cover in the landscape; the density of development; the average annual rainfall; the soil type and infiltrative capacity; residential and commercial development rates; the energy intensity of current imported and local water supply sources; the effects of evapotranspiration; and local conditions, such as the presence of contamination or of shallow groundwater that may affect groundwater recharge.

Because the study included only a subset of urban areas within California, and incorporated only residential and commercial development, the true value of LID is likely higher than the results indicate. For example, expanding the use of LID to include industrial, government, public use, and transportation development in Southern California alone would have the potential to yield an additional 75,000 af of water savings per year by 2030, with corresponding reductions in energy use and carbon dioxide emissions. Finally, opportunities to implement LID practices that infiltrate or capture stormwater exist statewide. Even greater overall water supply, energy use, and GHG emissions reductions benefits would result from full application of LID and other green infrastructure techniques throughout all of California.

The Natural Resources Defense Council and University of California, Santa Barbara, research demonstrates that LID offers important opportunities to address vital issues of water quality and quantity, while simultaneously addressing climate change and its impacts on California. The results from this analysis suggest that LID is a worthy investment to meet many of the challenges faced by local agencies and communities.

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Chapter 18. Pollution Prevention

Pollution prevention can be defined as the reducing or eliminating of waste at the source by modifying production processes, promoting the use of non-toxic or less toxic substances, the implementation of practices or conservation techniques including activities that reduce the generation and/or discharge of the pollutants, and the application of innovative and alternative technologies which prevent pollutants from entering the environment prior to treatment. These preventive activities can also include new equipment designs or technology, reformulation or redesign of products, substitution of raw materials, updating or improvements of existing management practices, continued maintenance of previously implemented management practices, training and education/outreach, and improved collaboration.

Pollution prevention begins at the source. Sources of water quality pollution can be categorized into two types: point-source and non-point-source. In California, point-source pollution prevention is addressed through the Clean Water Enforcement and Pollution Prevention Act of 1999, Water Code Section 13263.3(d)(1), which authorizes the State Water Resources Control Board (SWRCB), a Regional Water Quality Control Board (RWQCB), or a publicly owned treatment works (POTW) to require a discharger to prepare and implement a pollution prevention plan. A point-source discharger is defined per Water Code Section 13263.3(c) as any entity required to obtain National Pollutant Discharge Elimination System (NPDES) permit or any entity subject to the federal pretreatment program. A non-point discharger is any discharger not covered by a NPDES permit.

Pollution prevention can improve water quality for all beneficial uses by protecting water at its source and therefore reducing the need and cost for other water management and treatment options. By preventing pollution, restoring, and then protecting improved water quality throughout a watershed, water supplies can be used and reused by a greater number and types of downstream water uses. Improving water quality by protecting source water is consistent with a watershed management approach to water resources problems.

Under the public trust doctrine, certain resources are held to be the property of all citizens and are subject to continuing supervision by the State. Originally, the public trust was limited to commerce, navigation, and fisheries, but over the years, the courts have broadened the definition to include recreational and other ecological values.

As increasing emphasis is placed on protecting instream uses for fish, wildlife, recreation, and scenic enjoyment, surface water allocations administered under ever-tightening restrictions are posing new challenges and giving new direction to the SWRCB’s water rights activities. In a landmark case, National Audubon Society v. Superior Court, the California Supreme Court held that California water law is an integration of both public trust and appropriative right systems, and that all appropriations may be subject to review if “changing circumstances” warrant their reconsideration and reallocation. At the same time, it held that like other uses, public trust values are subject to the reasonable and beneficial use provisions of the California Constitution. Together with the SWRCB, the courts have concurrent jurisdiction in this area.

The difficulty comes in balancing the potential value of a proposed or existing water diversion with the impact it may have on the public trust. After carefully weighing the issues and arriving at a determination, the SWRCB is charged with implementing the action, which would protect the latter. The courts also have concurrent jurisdiction in this area.

As with all of the other pieces of the California water puzzle, protecting through pollution prevention, restoring/improving impaired water quality, and allocating the limited resource fairly and impartially among many competing users (while not creating or increasing water quality pollution issues with these allocations), are among some of the SWRCB's greatest challenges.

Pollution Prevention in California

In the past, the main water pollution prevention focus was primarily on those from point-source discharges. Pollution can enter a water body from point-sources like municipal wastewater treatment facilities, industrial wastewater treatment facilities, or municipal discharges from stormwater runoff. In recent years, however, as point-sources have been more effectively regulated and controlled, the remaining so-called "non-point-sources" (NPS) of pollution have become one of the main concerns of the SWQCB and RWQCBs. These NPS pollutants are generated from a variety of sources, including land use activities associated with agricultural operations and livestock grazing, forestry (silviculture) practices, uncontrolled urban runoff not covered by permits, deposition of airborne pollutants, hydromodification, and discharges from marinas and recreational boating activities. There are many approaches such as regulations (e.g., dischargers under the Water Code), voluntary/self-determined (e.g., locally led entities that desire a cleaner environment and that conduct riparian and ecosystem restoration activities), or incentive-based (e.g., U.S. Department of Agriculture Natural Resource Conservation Service Environmental Quality Incentives Program (EQIP) -National Water Quality Initiatives funding for implementing Agriculturally-based Management Practices) that are available for preventing NPS water pollution. Understanding, planning for, assessing, documenting, managing, tracking, and controlling NPS pollution through better land use management has been and will continue to be developed. Additional information on land use is available in the Land Use Categories and Pollution Prevention section in this chapter or in the Land Use Planning and Management, Chapter 24 in this volume.

Coordinating the prevention of both point- and non-point sources of pollution in concert with one another has been shown to help identify priority areas of focus. As resources continue to become increasingly limited, the ability to identify and focus funding resources through coordinated efforts will be of great importance.

The U.S. Environmental Protection Agency (USEPA), SWRCB, California Coastal Commission (CCC), and RWQCBs coordinate closely on NPS pollution issues. These agencies implement permitting, enforcement, remediation, monitoring, and watershed-based programs to prevent pollution. In addition, as part of California's NPS Program Fifteen-Year Strategy (NPS Program Strategy) that started in 1998, the SWRCB established an Interagency Coordinating Committee (IACC) to assist other state agencies with NPS regulatory authorities and/or land use responsibilities to familiarize themselves with each others' NPS activities, and to better leverage their resources. The Irrigated Lands Regulatory Program Roundtables and the Marina's IACC meetings continue to be two of the most effective of these originally formed groups.

NPS dischargers are responsible for ensuring that their discharges do not adversely impact water quality in the state. In an effort to prevent pollution, restore impaired water quality, and protect improved water quality, a number of government agencies provide funding for water quality projects using state bond funded grants and loans, and federal Clean Water Act section 319 (CWA 319) implementation grants. Some of the government agencies that administer and provide this funding include the SWRCB, Department of Water Resources, Department of Pesticide Regulations, Department of Conservation, and U.S. EPA. Unless new state water bond funding is approved by voters in the coming years, these bond funds will eventually be depleted with only the CWA 319 implementation grants continuing through the SWRCB. The amount of federal funding made available to the SWRCB for CWA 319 implementation grants has declined by 13% in 2010 and 10% in 2011. This funding is expected to continue to decline in the future. The need for increased CWA 319 federal funding and improved collaboration, cooperation, and leveraging of all funding sources will be extremely important in order to sustain a high level of water quality improvements, pollution prevention, and restoration efforts. The SWRCB NPS Program has identified watershed-based plan development and funding coordination for implementation as a high priority.

Pollution prevention can require a cultural change, one that encourages more anticipation and internalizing of real environmental costs by those who may generate pollution, and which also requires building a new relationship with all stakeholders to find the most cost-effective means to achieve those goals.

Antidegradation Policies

Pollution prevention can be provided through the adoption and implementation of policies to protect and/or maintain high water quality. The federal Clean Water Act requires each state to adopt a statewide antidegradation policy and establish procedures for its implementation. The California and federal antidegradation policies require, in part, that where surface waters have a higher quality than necessary to protect beneficial uses (e.g., designated uses of the water which can include, but are not limited to, domestic, municipal, agricultural and industrial supply, power generation, recreation, aesthetic enjoyment, navigation, and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves), the high quality of those waters must be maintained unless otherwise provided for by the policies. The federal antidegradation policy prohibits any activity or discharge that would lower the quality of surface water that does not have assimilative capacity with limited exceptions. The California Antidegradation Policy, which pre-dates the federal Clean Water Act, was adopted by the SWRCB in 1968 as SWRCB Resolution No. 68-16. SWRCB Resolution 68-16 establishes the requirement that state water discharges be regulated to achieve the “highest water quality consistent with maximum benefit to the people of the state.” The state’s Antidegradation Policy applies more comprehensively to water quality changes than the federal policy because it also applies to groundwater and not just surface water.

The Antidegradation Policy has been incorporated into all RWQCBs’ water quality control plans (basin plans). A basin plan establishes a comprehensive program of actions designed to preserve, enhance, and restore water quality in all water bodies within the state. The basin plan is each RWQCB’s master water quality control planning document and includes the beneficial uses of water within the RWQCB’s jurisdiction, water quality objectives to protect the beneficial uses, and a program of implementation to achieve the water quality objectives. Federal laws require states to adopt water quality standards. In California, the beneficial uses and water quality objectives are the state’s water quality standards.

Water Quality Monitoring

California Water Quality Monitoring Council

Senate Bill 1070 was enacted to orchestrate more effectively the many water quality monitoring efforts already in progress within the state, and to make that process more visible to users and to entities committed to the protection, monitoring, and supply of water to all its users. It provides for the creation of a structure to allow the public to access any available water quality data, current methods and research, as well as current regulations and enforcement actions. The bill also created the California Water Quality Monitoring Council to connect the myriad activities throughout the state in a more cohesive and sensible manner with the ability to provide direction to reduce redundancies, prioritize actions, and recommend funding necessary to provide the critical information necessary to protect California's water.

The California Water Quality Monitoring Council provides multiple perspectives on water quality information and highlights existing data gaps and inconsistencies in data collection and interpretation, thereby identifying areas for needed improvement in order to address the public's questions. The Monitoring Council has developed a set of "My Water Quality" Internet portals supported by expert stakeholder work groups, which include members from local, state, federal, and non-governmental organizations. The initial Internet portals were developed around water quality themes in an easy to understand manner and to answer the following water quality questions:

- Is It Safe To Swim In Our Waters?
- Is It Safe To Eat Fish and Shellfish From Our Waters?
- Are Our Ecosystems Healthy?

Additional "My Water Quality" Internet portals are planned and will address the following water quality questions:

- Is Our Water Safe to Drink?
- Are Our Stream and River Ecosystems Healthy?
- Are Our Tidepool Ecosystems Healthy?
- Are Our Estuary Ecosystems Healthy?
- Are Our Ocean Ecosystems Healthy?

Surface Water Ambient Monitoring Program

The Surface Water Ambient Monitoring Program (SWAMP) is a statewide monitoring effort that provides the scientifically sound data necessary to manage California's water resources effectively. Ambient monitoring refers to the collection of information about the status of the physical, chemical, and biological characteristics of the environment. The SWRCB and the RWQCBs introduced SWAMP in 2001. The program's purpose is to monitor and assess water quality to determine whether California is meeting its water quality standards and protecting its beneficial uses. Data from SWAMP are used to improve the state's water quality assessment and impaired water bodies list, required under CWA Sections 305(b) and 303(d), respectively. In addition, regional efforts underway by the Central Coast Ambient Monitoring Program are briefly described in Box 18-1.

PLACEHOLDER Box 18-1 Central Coast Ambient Monitoring Program

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Groundwater Ambient Monitoring and Assessment Program

The Groundwater Ambient Monitoring and Assessment (GAMA) Program was created in 2000 by the SWRCB and it is California's comprehensive groundwater quality monitoring program. GAMA collects data by testing the untreated, raw water in different types of wells for naturally-occurring and human-made chemicals. GAMA compiles these test results with existing groundwater quality data from several agencies into a publicly-accessible Internet database called Geo-Tracker GAMA and is available at http://geotracker.waterboards.ca.gov/gama/. The main goals of GAMA are to improve statewide groundwater monitoring and increase the availability of groundwater quality information to the public.

California Monitoring and Assessment Program

In 2004, California Monitoring and Assessment Program for Wadeable Perennial Streams was initiated. This program builds on U.S. EPA's Environmental Monitoring and Assessment Program using a probabilistic monitoring design incorporating land use classes to allow for assessments of status and trends in aquatic life beneficial use protection in streams. Historic Environmental Monitoring and Assessment Program data were analyzed to produce assessments of the condition of streams statewide and in special study areas in Northern and Southern coastal California. Several assessments will also be completed focusing on providing water quality information statewide, and for the broad land use categories such as urban, agriculture, and forested areas. Based upon the highly extrapolative nature of this program, practitioners with intimate familiarity with specific water body conditions have questioned the sensitivity of this approach to identifying barriers to migration, which cause impairment to anadromous fish populations in water bodies displaying generally good water quality. These efforts directly relate to Recommendation 3 of this strategy in the 2005 California Water Plan and can be seen as some success in responding to this recommendation.

Since 2000, California has conducted three successive probability surveys of its perennial streams and rivers, each with a focus on biological endpoints. These surveys are now combined and are managed collectively by the SWAMP under its Perennial Streams Assessment Program. In 2010, SWAMP's Perennial Streams Assessment conducted the SWRCB's eleventh continuous year of probability monitoring of perennial, wadeable streams. To date, the program has collected biological data (invertebrates, algae) and associated chemical and habitat data from approximately 850 probabilistic sites statewide. These surveys have produced a wealth of data that can and should be used to inform many decisions made by California's water resource agencies. For example, the assessments in the 2006 *California Water Quality Assessment Report* (Clean Water Act Section 305(b) Report) were based in large part on data from these surveys. Data from these surveys were also used in the development of the *2010 Integrated Report* (Ode, Kincaid, Fleming, Rehn 2011).

Surface Water Quality Assessment and Total Maximum Daily Loads (TMDLs)

The CWA Section 305(b) requires each state to report biennially on the quality and condition of its waters. CWA Section 303(d)(1)(A) requires each state to identify waters within its boundaries which are not meeting water quality standards. The reports submitted by states serve as the basis for U.S. EPA's *National Water Quality Inventory Report to Congress.* The SWRCB and RWQCBs conduct physical, chemical, and biological monitoring of the waters of the state and prepare a biennial assessment report for U.S. EPA (SWRCB 2012a).

California's CWA Section 303(d) (CWA 303d) Listing Policy sets the rules to identify which waters do not meet water quality standards, even after point-source dischargers have installed the required levels of pollution control technology (SWRCB 2009a). The federal law requires that states establish priority rankings for water on the CWA Section 303(d) list and develop action plans, called Total Maximum Daily Loads (TMDLs) for specific pollutants to improve water quality and protect designated beneficial uses. TMDLs can take various forms, but most commonly are adopted through the basin plans for the region.

Water bodies are most often listed as impaired for sediment, pathogens, nutrients, increased temperature, pesticides, metals, and organic chemicals. The resulting TMDLs are then implemented through the point-source and NPS regulatory programs such as:

- National Pollutant Discharge Elimination System (NPDES) permits for point-sources (e.g., wastewater treatment facilities, stormwater runoff).
- State waste discharge requirements (WDRs) for point-sources not subject to the NPDES permit program and non-point-source (NPS) discharges.
- Prohibitions for discharges other than agriculture.
- Conditional waivers of WDRs.

Multiple pollutants can be addressed in a single TMDL or multiple water bodies in a watershed may be addressed in a single TMDL. The RWQCBs are currently developing more than 181 TMDLs, addressing approximately 255 listings in 2011-12. Schedules have been developed for establishing all required TMDLs during a 13-year period. More detailed schedules of work to be undertaken in the short-term have also been developed. The SWRCB *Annual Performance Report* currently provides the number of TMDLs adopted, number of listings addressed by TMDLs, and total number of listings remaining. These performance reports are updated annually and are available at http://www.waterboards.ca.gov/about_us/performance_report_1112/plan_assess/#more.

Many significant pollution problems today are the result of persistent legacy pollutants, such as mercury, that were extracted from the Coastal Range and were used to process gold in the Sierra Nevada mines in the 19th century, industrial chemicals, such as polychlorinated biphenyls (PCBs) used in electrical transformers, and pesticides such as dichlorodiphenyltrichloroethane (DDT). These pollutants also contaminate sediments, making ecosystem restoration efforts more difficult. Hydraulic mining during the 1900s still has an adverse impact on numerous Central Valley rivers and the San Francisco Bay, as well as major parts of the Klamath River watershed. Some environmental contaminants of concern, such as mercury, selenium, PCBs, and DDT are persistent and/or are bioaccumulative. Their concentration and toxicity magnify in the food chain and could be toxic to key food chain links such as aquatic invertebrates. These contaminants also negatively impact communities and Native American tribes dependent upon subsistence fisheries.

In 2011, the U.S. EPA issued its final decision regarding the water bodies and pollutants added to California’s 303(d) Lists and 305(b) Reports, referred to as the *2010 Integrated Report*. This supersedes the 2006 California Clean Water Act 303(d) List as California’s current 303(d) List. The 2010 California CWA 303(d) List now includes 87,399 impaired river miles and 7,582,984 acres of impaired lakes and bays. In some cases, a water body is listed for more than one pollutant. There are a total of 3,489 pollutant-water body listings. There have been a total of 1,473 listings addressed, 957 of which were addressed by a TMDL and during the 2010 303(d) listing cycle, and 122 de-listings to date. The *2010*

Integrated Report includes a web-based interactive map and is available at http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml.

Groundwater Quality

Human activities increase the discharge of salt, nitrates/nutrients, and other pollutants to land. Such activities include the application of fertilizers (even at accepted optimal agronomic rates), application of imported water for irrigation containing dissolved salts, and industrial, municipal, and domestic wastewater discharges. Salts are leached to groundwater by rainfall or irrigation practices. Additionally, salts in native soils can be dissolved by irrigation water and leached to groundwater. For additional discussion, see Chapter 19, Salt and Salinity Management in this volume.

Nitrate pollution of groundwater results from various sources including the use of nitrogen fertilizers, percolation of wastewater treatment plant and food processing wastes, leachate from septic system drainfields, animal corals, manure storage lagoons, urban parks, lawns, golf courses, and leaky sewer systems. A recent study of the Tulare Lake basin and Salinas Valley growing areas found that nitrate from agricultural fertilizer is the largest threat to groundwater quality in these areas (Harter et al. 2012). Nitrate contamination of community water system wells is also the most frequently detected anthropogenic (human-caused) contaminant, affecting more than 450 wells that are used by more than 200 community water systems statewide (SWRCB 2013). Wellhead treatment programs and blending with higher quality water are both effective at reducing the nitrate level in drinking water supplies. However, the extra cost to remove or reduce nitrate to below safe levels is often expensive and unaffordable for disadvantaged communities. Individual residences served by domestic wells are also at risk if these are located in or near known areas of nitrate contamination. Domestic wells generally tap shallow groundwater making them more susceptible to contamination. Many of these well owners are unaware of the quality of the well water, because the State does not require them to test their water quality. For additional discussion on groundwater contamination, see Chapter 16, Groundwater/Aquifer Remediation in this volume.

Groundwater Recharge Area Protection

Protecting recharge areas is important since they provide a primary means to replenishing groundwater supplies. Good natural recharge areas are those where good quality surface water is able to percolate unimpeded to groundwater. If recharge areas cease functioning properly, there may be insufficient groundwater storage for later use. Protection of recharge areas requires a number of actions based on two primary goals: (1) ensuring that areas suitable for recharge continue to be capable of adequate recharge rather than become covered by urban infrastructure such as buildings and roads, and (2) preventing pollutants from entering the groundwater in order to avoid expensive treatment that would be needed prior to potable, agricultural, or industrial uses.

Protection of recharge areas is necessary to maintain the quantity and quality of groundwater in the aquifer. However, protecting recharge areas by itself does not provide a supply of water. Recharge areas only function when aquifer storage capacity is available, and when regional and local governments and agencies work together to protect or secure an adequate supply of good quality water to recharge the aquifer. Climate change may alter precipitation and runoff patterns, which will impact groundwater recharge (see the Climate Change section in this chapter). Protecting existing and potential recharge areas allows them to serve as valuable components of a conjunctive management and a groundwater storage strategy.

Zoning can play a major role in protecting a recharge area by amending land use practices so that existing recharge sites are retained as recharge areas. In the past, some areas that provided good rates of recharge were paved over or built upon and are no longer available to recharge the aquifer. Local governments often lack a clear understanding of recharge areas and the need to protect those areas from development or contamination. Land use zoning staff does not always recognize the need for recharge area protection for water quantity and water quality. For further discussion, see Chapter 25, Recharge Area Protection in this volume.

Drinking Water Source Assessment and Protection

Drinking water originates from streams, rivers, lakes, and underground aquifers. These sources usually require water treatment to remove contaminants before it is delivered to customers as drinking water. However, the cost and level of water treatment, as well as the risks to public health, can all be reduced by protecting source water from contamination. Establishing drinking water source assessment and protection programs are necessary to identify contaminating activities and implement practices to protect source water. Ultimately, everyone from government agencies to local communities, including business and citizens, plays a role to ensure that drinking water sources are protected.

Assessment of Drinking Water Sources

The assessment of drinking water sources is the first step to develop a complete drinking water source protection program. A source water assessment is a study that defines the land area contributing water to a public water system source, identifies the major potential contamination activities that could affect the drinking water supply, and determines how susceptible the public water supply is to this potential contamination. The Safe Drinking Water Act requires states to develop U.S. EPA-approved programs to carry out assessments of all source waters in their state. Local communities, water systems, and citizens can then use the publicly available study results to the take actions to reduce potential sources of contamination and protect drinking water (U.S. EPA 2012). In California, most source water assessments for public drinking water sources have been completed and are available at http://swap.ice.ucdavis.edu/TSinfo/TSintro.asp.

In addition to source water assessments, public water systems that treat surface water are required to conduct a watershed sanitary survey every five years. At a minimum, this survey includes:

- Physical and hydrogeological description of the watershed.
- Summary of source water quality monitoring data.
- Description of watershed activities and sources of contamination that affect source water quality.
- Description of any significant changes that have occurred since the last survey, which could affect the source water quality.
- Description of watershed control and management practices.
- Evaluation of the system's ability to meet water treatment requirements.
- Recommendations for corrective actions to improve source water quality.

These watershed sanitary surveys provide an assessment of the watershed, identify possible contamination sources, and recommends actions needed to protect and improve source water quality.

Protection of Drinking Water Sources

In California, drinking water systems are encouraged to establish a source water protection program to protect their supply sources from contamination. Source water protection measures are practices to prevent contamination of groundwater and surface water that are used or are potentially used as sources of drinking water. These include non-regulatory measures, such as Best Management Practices (BMPs), and regulatory methods such as issuing permits. A source water protection program is a valuable tool for the following reasons:

- It is the most cost-effective method to ensure the safety of a drinking water supply.
- It is part of a multi-barrier approach to provide safe drinking water; treatment alone cannot always be successful in removing contaminants.
- It improves public perception of the safety of drinking water.
- It helps to ensure safe drinking water that is essential for public health and economic well-being of communities.

A drinking water source protection program envisions a partnership between local, state, and federal agencies to ensure that the quality of drinking water sources is maintained and protected. Recently, the Central Valley RWQCB launched a multi-year effort to develop a drinking water policy for surface waters in the Central Valley, see Box 18-2.

PLACEHOLDER Box 18-2 Central Valley Drinking Water Source Policy

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Land Use Categories and Pollution Prevention

The state NPS Program addresses NPS pollution by promoting management measures (MMs) and management practices (MPs) for each of the six separate land use categories: agriculture, urban, forestry (silviculture), marinas and recreational boating, hydromodification, and wetlands. Management measures serve as general goals for the control and prevention of polluted runoff. Site-specific MPs are then used to achieve the goals of each management measure. Management practices refer to specific technologies, processes, siting criteria, operating methods, or other alternatives to control NPS pollution.

The SWRCB, the RWQCBs, and the California Coastal Commission have developed and adopted successive, five-year plans (NPS Implementation Plans) to implement the NPS Program Strategy. The NPS 15-Year Strategy (1998-2013) focuses on the progress made in the NPS Program thus far, describes the additional regulatory, educational, and financial tools made available to the RWQCBs, and identifies the need for prioritizing resources and efforts. The goals of the current NPS Implementation Plan are similar to those of the past five-year plans (2008-2013) with a closer focus on the following activities:

- Implementing the Policy for the Implementation and Enforcement of the Nonpoint Source Pollution Control Program (NPS Implementation and Enforcement Policy) by the RWQCBs, particularly through the RWQCB's use of regulatory tools.
- Concentrating NPS resources on TMDL planning, assessment and implementation priorities, and shifting these funds away from pollution prevention outreach.

- Improve coordination and leveraging of resources with other funding organizations such as USDA (EQIP), SWRCB's Clean Water State Revolving Fund (CWSRF), Department of Conservation Watershed Program Grants, Department of Water Resources Integrated Regional Water Management, and others.
- Focusing overall efforts and resources on high priority watersheds and problems, as defined by priority TMDLs and other region-specific problems.
- Acknowledging the balancing act required by SWRCB programs to clean up waters polluted by non-point-sources and to preserve clean waters.

In the next five years, the SWRCB expects to have a fully integrated database of existing and tested management measures and management practices, many success stories based on proper implementation and maintenance of these measures and practices, well-established cleanup programs based on actions taken pursuant to the NPS Implementation and Enforcement Policy, and an accurate assessment of the remaining NPS pollution problems in the state. The NPS Program Strategy will be updated by the SWRCB NPS Program after receiving new U.S. EPA NPS Program Plan guidance. The goal of this new guidance is to ensure a more cohesive and consistent set of NPS Strategies and reporting requirements for all states. At this time, the SWRCB will be well-positioned to take another long-term look at the future of NPS pollution cleanup priorities.

The SWRCB has developed the NPS Encyclopedia (http://www.waterboards.ca.gov/water_issues/programs/nps/encyclopedia.shtm) to help practitioners choose management practices for implementation. It is a free, online reference guide designed to facilitate a basic understanding of NPS pollution control and to provide quick access to essential information from a variety of sources. This is done through hyperlinks to other resources available on the Internet. The purpose of the NPS Encyclopedia is to support the implementation and development of the NPS aspects of TMDLs and watershed action plans with a goal of protecting high quality waters and restoring impaired waters. The companion tool, the Management Practices MP Miner (http://mpminer.waterboards.ca.gov/mpminer/), allows users to cull data from studies of management practices, peer reviewed and otherwise, by filtering studies using relevant site-specific variables, such as land use category, pollutant of concern, and removal efficiency required. Both tools are available at the SWRCB Web site as indicated above.

Agriculture

Agricultural activities that cause NPS pollution can include poorly located or managed animal feeding operations, overgrazing, plowing too often or at the wrong time, and improper, excessive, or poorly timed application of pesticides, irrigation water, and fertilizer. Farm and ranching pollutants include sediment, nutrients, pathogens, pesticides, metals, and salts. To control NPS pollutants generated from this land use category, agricultural management measures should address:

- Erosion and sediment control.
- Facility wastewater and runoff from confined animal facilities.
- Nutrient management.
- Pesticide application.
- Grazing management.
- Irrigation water management.
- Education and outreach.

Urban

Controlling polluted runoff in urban areas is a challenge. Negative impacts of urbanization on coastal and estuarine waters are well documented in a number of publications including California's CWA Section 305(b) and Section 303(d) reports and the Nationwide Urban Runoff Program. Major pollutants found in runoff from urban areas include sediment, nutrients, oxygen-demanding substances, road salts, heavy metals, petroleum hydrocarbons, plastics, pesticides, pathogenic bacteria, and viruses. In addition to organic carbon and pathogens, suspended sediments constitute the largest mass of pollutant loadings from urban areas into receiving waters. Construction is a major source of sediment erosion. Petroleum hydrocarbons result mostly from automobile sources. Plastics, including plastic bags and bottles, are mainly the result of urban runoff. Nutrient and bacterial sources include garden fertilizers, leaves, grass clippings, pet wastes, homeless encampments, and faulty septic tanks. As population densities increase, there is a corresponding increase in trash and pollutant loadings that is generated from human activities. Many of these pollutants enter surface waters via runoff without undergoing treatment. To control NPS pollutants generated from this land use category, urban management measures should address:

- Runoff from developing areas, construction sites, and existing development.
- Septic tank systems.
- Transportation development (roads, highways, and bridges).
- Education and outreach.

Forestry (Silviculture)

Silviculture can contribute pollution to rivers and lakes. Without adequate controls, forestry operations may degrade the characteristics of waters that receive drainage from forest lands. Sediment concentrations can increase due to accelerated erosion, water temperatures can increase due to removal of over-story riparian shade, dissolved oxygen can be depleted due to the accumulation of slash and other organic debris, and concentrations of organic and inorganic chemicals can increase due to harvesting, fertilizers, and pesticides. To control NPS pollutants generated from this land use category, forestry management measures should address:

- Preharvest planning.
- Streamside management areas.
- Road construction/reconstruction.
- Road management.
- Timber harvesting.
- Site preparation/forest regeneration.
- Fire management.
- Revegetation of disturbed areas.
- Forest chemical applications.
- Wetland forest management.
- Postharvest evaluation.
- Education and outreach.

Marinas and Recreational Boating

Recreational boating and marinas are increasingly popular uses of coastal areas and inland surface water bodies (e.g., lakes, the Sacramento-San Joaquin Delta, and San Francisco Bay), and they are an important means of public access to navigable waterways. Therefore, California must balance the need for protecting the environment and the need to provide adequate public access. Because marinas and boats are located at the water's edge, pollutants generated from these sources are less likely to be buffered or filtered by natural processes. When boating and adjunct activities (e.g., those that take place at marinas and boat maintenance areas) are poorly planned or managed, they may pose a threat to water quality and the health of aquatic systems.

Water quality issues associated with marinas and recreational boating include:

- Poorly flushed waterways.
- Pollutants discharged from the normal operation of boats (recreational boats, commercial boats, and live-aboards).
- Pollutants carried in stormwater runoff from marinas, ramps, and related facilities.
- Physical alteration of wetlands and of shellfish/other benthic communities during construction of marinas, ramps, and related facilities.
- Pollutants generated from boat maintenance activities on land and in the water.
- Dredging in marinas and boat maintenance areas.
- Introductions of aquatic invasive species, both plant and animal, that degrade water quality, ecosystem processes, and water infrastructure.

Common pollutants generated from marinas and recreational boating activities include copper, bacteria and pathogens, oil and grease, nutrients, and aquatic and invasive species such as quagga mussels and *Caulerpa taxifolia*. To control NPS pollutants generated from this land use category, marina and recreational boating management measures should include:

- Marina facility assessment, siting, and design – water quality assessment, marina flushing, habitat assessment, shoreline stabilization, stormwater runoff, fueling station design, sewage facilities, and waste management facilities.
- Operation and maintenance – solid waste control, fish waste control, liquid material control, petroleum control, boat cleaning and maintenance, sewage facility maintenance, and boat operations.
- Education and outreach.

Hydromodification

Hydromodifications that can impair water quality include channel modification (channelization), flow alterations, levees, and dams. Channel modification activities are undertaken in rivers or streams to straighten, enlarge, deepen, or relocate the channel. These activities can affect water temperature, change the natural supply of fresh water to a water body, and alter rates and paths of sediment erosion, transport, and deposition. Hardening the banks of waterways with shoreline protection or armor also accelerates the movement of surface water and pollutants from the upper reaches of watersheds into coastal waters.

Channelization can also reduce the suitability of instream and streamside habitat for fish and wildlife by depriving wetlands and estuarine shorelines of beneficially-enriching sediments, affecting the ability of natural systems to filter pollutants, and interrupting the life stages of aquatic organisms. Dams can adversely impact hydrology, the quality of surface waters, and riparian habitat in the waterways where the dams are located. A variety of impacts can result from the siting, construction, and operation of these facilities. For example, improper siting of dams can inundate both upstream and downstream areas of a waterway. Dams reduce downstream flows, thus depriving wetlands and riparian areas of water. During dam construction or dredging, removal of vegetation and disturbance of underlying sediments can increase turbidity and cause excessive sedimentation in the waterway. Further, metered flows from dams fail to exert the forces that build and maintain channel structure and beneficial floodplain functions.

The erosion of shorelines and streambanks is a natural process that can have either beneficial or adverse impacts on riparian habitat. Excessively high sediment loads resulting from erosion can smother submerged aquatic vegetation, cover shellfish beds and tidal flats, fill in riffle pools, and contribute to increased levels of turbidity and nutrients (U.S. EPA 2009a). To control NPS pollutants generated from this land use category, hydromodification management measures should address:

- Channelization-channel modification.
- Dam construction and operation – erosion and sediment control and chemical pollutant control issues, and the downstream impact of reservoir releases on riparian habitat.
- Streambank and shoreline erosion control.
- Education and outreach.

Wetlands

Wetlands and riparian areas reduce polluted runoff and enhance water quality by filtering out runoff-related contaminants, such as fine-grained sediment, nutrients (nitrogen and phosphorus), and some metals. Functional wetlands and riparian systems provide other services such as surface and groundwater storage, flood control (with adequate set-backs), and storm surge attenuation. They also support valuable wildlife and aquatic habitats. Highly modified wetlands and riparian systems are typically managed for a few beneficial uses or services, are costly to maintain, and have questionable long-term sustainability. Natural wetlands are self-sustaining when not adversely impacted by pollution.

Changes in hydrology, soil texture, water quantity, and/or species composition can impair the ability of wetland or riparian areas to filter out excess sediment and nutrients and therefore can result in deteriorated water quality. Wetlands and riparian areas may be impacted or destroyed by construction, filling, or other alterations. Historically, significant losses of wetlands have been caused by draining wetland soils for conversion to croplands, or dredging wetland soils for waterway navigation. Spongy wetland soils are compacted by over-grazing and grading. Loss of wetland acreage increases polluted runoff, leading to degradation of surface water quality.

To control NPS pollutants generated from this land use category, wetlands management measures should address:

- Protection of wetlands and riparian areas.
- Restoration of wetlands and riparian areas.
- Vegetated treatment systems.
- Education and outreach.

Potential Benefits

For the vast majority of contaminants, it is generally accepted that a pollution prevention approach to water quality is more cost-effective than end-of-the-pipe treatment of wastes or advanced domestic water treatment for drinking water. Pollution prevention measures that treat or manage concentrated pollutants at the source are usually more cost-effective and practical than attempting to treat larger downstream flows that have diluted the pollutant. By preventing further degradation of water through pollution prevention, there is an overall improvement of water quality over time in both surface and groundwater.

Pollution prevention can be considered in the context of adaptation, while pollution treatment is generally associated with mitigation.

Pollution prevention activities, such as stormwater runoff management and low-impact development, can reduce or maintain the peak runoff from urbanized areas such that they can meet the channel capacity of the natural system without the need to construct new protection structures. Additional information is available in Chapter 20, Urban Stormwater Runoff Management in this volume.

Small rural water systems, which generally lack technical and financial capacities, may be more reliant upon pollution prevention measures than other options available to larger systems, such as advanced treatment. When surface water is polluted, the only other available source is groundwater. Therefore, preventing pollution of surface water keeps options for water supply open, which is especially important in areas where the groundwater resources may already be in overdraft.

By protecting the quality of surface water and near-shore coastal waters, this management strategy provides multiple benefits or uses by providing opportunities for water recreation activities, as well as serving as a water source for desalination plants, and maintaining suitable habitat for wildlife. A number of NPS success stories have been highlighted by U.S. EPA, see Box 18-3 for additional information.

PLACEHOLDER Box 18-3 U.S. EPA Non-point-Source Success Stories

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Potential Costs

According to the 2008 U.S. EPA Clean Watersheds Needs Survey, California needs more than $30 billion to meet water quality and water-related public health goals of the Clean Water Act (U.S. EPA 2009b). This survey emphasized point-source discharges from wastewater treatment systems, which estimated more than $20 billion is needed to prevent point-source discharges. Measures to address and prevent NPS pollution were likely underestimated. Currently, U.S. EPA is conducting the 2012 Clean Watersheds Needs Survey and the timeline to release the final report in late 2013. There have been a number of requests and recommendations to represent the funding need for NPS pollution more accurately in the 2012 survey.

An assessment of water quality conditions in California shows that NPS pollution has the greatest effect on water quality. It affects some of the largest economic segments of the state's economy, ranging from agriculture to the tourist industry. As previously discussed, non-point-sources are not readily controlled by conventional means. Instead, they are controlled with preventive plans and practices used by those directly involved in those activities and by those overseeing such activities. The following examples provide some insight into the complexity and costs associated with NPS pollution prevention in California.

Clean Beaches

Runoff from urban areas can contain heavy metals, pesticides, petroleum hydrocarbons, trash, plastics, and animal and human waste (Heal the Bay 2009). This urban runoff can have a detrimental impact on one of California's greatest natural and economic resources, its world-renowned beaches. This natural resource attracts millions of tourists and locals each year. The direct revenues generated by the California beach economy are substantial. Unfortunately, runoff from creeks, rivers, and storm drains creates the largest source of water pollution for the beaches. Often the currents in the bays, around offshore islands, and along sections of the coast can exacerbate pollution by trapping or directing pollutant to a particular area along the coast. Some stretches of beaches in Southern California are permanently posted by local health departments as being unsafe for swimming and surfing, or they periodically post such warnings after storm events. It is recommended that no one swim in the ocean during a significant rain event and for at least three days following a significant rain event due to contaminated urban stormwater runoff draining directly into the ocean. During dry weather, California beaches experience much better water quality, although sewer spills that result in beach closures and other sources of pollution exist year-round.

In response to the poor water quality and significant exceedences of bacterial indicators revealed through monitoring at California's beaches, the Clean Beaches Initiative (CBI) Grant Program was initiated by Assembly Bill 411 (Statutes of 1997, Chapter 765). The water quality goal of the CBI is to make beaches safe for recreational ocean water contact. The CBI Grant Program provides funding for projects that restore and protect the water quality and the environment of coastal waters, estuaries, bays, and near-shore waters. Scientific studies have shown that water with high bacteria levels can cause infections, rashes, and gastrointestinal and respiratory illnesses (SWRCB Clean Beaches Initiative 2001).

The CBI Grant Program has provided about $100 million from voter-approved bonds for approximately 100 projects since it began under the 2001 Budget Act. Typical projects include the construction of disinfecting facilities, diversions that prevent polluted storm water from reaching the beach, and scientific research that will enable early notification of unhealthy swimming conditions.

California beaches are an important environmental and economic resource for the state and the nation. Efforts such as the CBI that fund stormwater diversions and other water quality improvement projects are creating benefits that will likely far outweigh their costs. For more information on CBI, go to http://www.swrcb.ca.gov/water_issues/programs/beaches/cbi_projects/index.shtml.

Irrigated Agriculture

In 2012, the Central Valley RWQCB adopted general waste discharge requirements for growers in the Eastern San Joaquin River watershed that are members of the third-party group (East San Joaquin Water Quality Coalition) representing the area. The order covers an estimated 3,600 growers with 835,000 acres under production. The Central Valley RWQCB estimates that the total cost of compliance with this order is expected to be approximately $99 million dollars per year or $119 per acre annually. Approximately $113 of the $119 per acre annual cost is associated with implementation of management practices to protect surface and groundwater quality. Other costs included in the total amount are third-party costs (monitoring, reporting, tracking, and administration), state fees, and farm plans (Central Valley RWQCB 2012a).

Major Implementation Issues

Irrigated Agriculture

Many surface water bodies are impaired because of pollutants from agricultural sources. Statewide, approximately 7,986 miles of rivers/streams and some 310,370 acres of lakes/reservoirs are on the state's impaired water bodies list or Clean Water Act 303(d) list as being impaired by runoff from irrigated agriculture. Agricultural discharges including irrigation return flow, flows from tile drains, and stormwater runoff affect water quality by transporting pollutants such as pesticides, sediments, nutrients, salts (including selenium and boron), pathogens, and heavy metals from cultivated fields into surface waters. Groundwater bodies have also suffered pesticide, nitrate, and salt contamination. A recent report by UC Davis titled *Addressing Nitrate in California's Drinking Water with a Focus on Tulare Lake Basin and Salinas Valley Groundwater* (Harter et al. 2012) found that agricultural fertilizers and animal wastes applied to cropland are by far the largest regional sources of nitrate in groundwater in the Tulare Lake basin and Salinas Valley.

In an effort to control and assess the effects of discharges from irrigated agricultural lands, the Los Angeles, Central Coast, Central Valley, and San Diego RWQCBs have adopted comprehensive conditional waivers of waste discharge requirements. The Colorado River and North Coast RWQCBs have adopted Conditional Prohibitions as a TMDL implementation plan incorporated into their respective basin plans, and the Santa Ana Region RWQCB is in the initial phase of developing an irrigated lands regulatory program. In the future, other RWQCBs may also adopt waivers for agricultural discharges in order to implement TMDLs. An estimated 40,000 growers, who cultivate more than 9 million acres, are subject to RWQCBs' irrigated agriculture regulatory programs in these regions. These RWQCBs have made significant strides to implement their irrigated agriculture regulatory programs and are committed to continue their efforts to work with the agricultural community to protect and improve water quality.

Urban Impacts

Urbanization alters flow pathways, water storage, pollutant levels, rates of evaporation, groundwater recharge, surface runoff, the timing and extent of flooding, the sediment yield of rivers, and the suitability and viability of aquatic habitats. The traditional approach to managing urban and stormwater runoff has generally been successful at preventing flood damage, but it has several disadvantages. In order to convey water quickly, natural waterways are often straightened and lined with concrete, resulting in a loss of habitat and negatively impacting natural stream physical and biological processes. Urbanization creates impervious surfaces, meaning stormwater does not infiltrate into subsurface aquifers. This increases runoff volumes and velocities, resulting in streambank erosion and potential flooding problems downstream.

Urban runoff from both storm-generated and dry weather flows has also been shown to be a significant source of pollution by washing contaminants such as nutrients (lawn fertilizers and pet wastes), pesticides, oil and grease, metals, organic chemicals, human pathogens, and debris (especially plastics and plastic particulates) from city streets and other hard surfaces into surface waters and beaches.

One approach to address urban runoff is the watershed approach, which attempts to emulate and preserve the natural hydrologic cycle that is altered by urbanization. The watershed approach consists of a series of Best Management Practices designed to reduce the pollutant loading and reduce the volumes and velocities of urban runoff discharged to surface waters. These Best Management Practices may include facilities to capture, treat, and recharge groundwater with urban runoff, public education campaigns to inform the public about stormwater pollution, including the proper use and disposal of household chemicals, and technical assistance and stormwater pollution prevention training. Additional information is available in Chapter 20, Urban Stormwater Runoff Management and Chapter 25, Recharge Area Protection in this volume.

Legacy Pollutants

Arsenic, asbestos, radon, minerals, and sometimes microorganisms and sediment are examples of naturally occurring contaminants for which a pollution prevention approach is not applicable. Furthermore, some contaminants that are of concern specifically for drinking water, such as arsenic found to occur naturally in groundwater, organic carbon from watershed runoff, and bromide from ocean salinity, are a result of natural processes for which a pollution prevention approach is not possible. While there are natural sources of organic carbon, anthropogenic sources from agriculture drainage, urban runoff, and wastewater discharges typically contain higher concentrations of organic carbon than natural runoff.

Abandoned mines and former industrial and commercial sites, such as gas stations and dry cleaning operations, often leave behind contamination problems without a clear link to any legally responsible or financially viable party or entity to pay for the cleanup. State and federal governments and potentially responsible parties often become involved in extensive regulatory and legal proceedings to determine the legal and financial responsibility while the contaminants remain.

Contaminants of Emerging Concern

Traditionally, drinking water systems focus on pathogens (disease-causing microorganisms), chemicals, and disinfectant by-products (potential cancer-causing contaminants) that are regulated or will be regulated in the near future. Recently, other unregulated chemicals and pollutants have been discovered to have unexpected health and environmental effects. Chemicals found in pharmaceuticals and personal care products (PPCPs), by-products of fires and fire suppression, and discarded elements of nanotechnology are emerging as actual or potential water contaminants. Most of these emerging pollutants have not yet been subject to rigorous assessment or regulatory action.

The SWRCB is preparing an amendment to the Recycled Water Policy to include monitoring requirements for constituents of emerging concern (CECs) in recycled water for indirect potable reuse (i.e., groundwater recharge of a drinking water aquifer). In addition, to assess the aquatic life impacts of pharmaceutical discharges, the State has recently contracted for research in development and evaluation of bioanalytical screening or bioassay techniques for potential application in recycled water monitoring. The goal is to develop high throughput bioassays for the screening of compounds for specific biological target activities (e.g., endocrine disruption, etc.).

Institutional Barriers

Institutional barriers can contribute to the difficulty of addressing pollution from uncontrolled runoff, especially as the state moves towards a broader watershed approach to pollution prevention and regulatory action. Various state, local, and federal agencies have divided jurisdiction over groundwater versus surface waters, polluted runoff versus point-source discharges, water quantity versus water quality issues, and even over monitoring and assessing pollutants. These various “stovepipes” of regulatory authority can hamper the more holistic watershed approach to water quality management, and will need to be addressed in the coming years. Management and regulation of water quality in California is fragmented among at least eight state and federal agencies, and no one agency is totally responsible for water quality from source to tap. For example, the SWRCB and RWQCBs regulate ambient water quality, while the Department of Public Health primarily regulates treatment and distribution of potable water. Further, surface water storage and conveyance in California is managed mostly by the Department of Water Resources and the U.S. Bureau of Reclamation, while groundwater is usually not managed in a coordinated manner at all. Moreover, providing drinking water to Californians is an obligation of cities, water districts, private water companies, and small water systems that generally were not formed in any comprehensive pattern.

Efforts to coordinate, collaborate, and leverage various agency authorities towards improvements of water quality in California have been initiated and will need to continue in order to alleviate these institutional barriers. Finally, the diffuse nature of NPS pollution and the need to control sources on private and public land adds to the difficulties of instituting pollution prevention measures.

Climate Change

Climate change may exacerbate concentrations of pollutants in rivers and lakes from multiple sources. Higher temperatures will cause more algal blooms, reducing dissolved oxygen levels and decreasing filter capacity. Storm events following forest fires may result in increased deposition of pollutants in waterways. Also, pesticide application may increase as more pests survive warmer and drier winter conditions. In the urban environment, the projected stronger storms may also overwhelm urban stormwater systems, leading to additional dispersion of pollutants into waterways.

Adaptation

New standards for land use and development, such as fewer impervious surfaces, more on-site use of rainwater, and more vegetated areas should assist to reduce the amount of pollution in populated areas. Forest management techniques, such as small biomass removal and integrated pest management practices, can also reduce the likelihood of catastrophic fires and increased pesticide use to combat pest infestations. Another adaptation measure may include higher levels of treatment for discharges into rivers and lakes. In the agricultural sector, reduced application of nitrogen-based fertilizers could advance adaptation by maintaining groundwater quality for beneficial uses.

Mitigation

Vehicles are one of the major mobile (non-point) sources of pollution. Shifts to reduce vehicle use and away from gasoline-fueled vehicles may reduce the volume of pollutants entering waterways. Fewer pollutants could result in reduced water treatment needs, which would mean less energy usage and fewer GHG emissions. Further adoption of low-impact development measures could also reduce pollution in urban settings. In agricultural settings, additional use of integrated pest management and reduced fertilizer application techniques could reduce the energy use associated with pesticide application and groundwater nitrates treatment. In recognition that biomass resources generated by agriculture can be used as an energy source and as a strategy to address climate change, the dairy industry developed digester facilities that produce electricity from dairy manure. The Central Valley RWQCB supported this effort with the adoption of general waste discharge requirements (Order R5-2010-0116 and R5-2011-0039) that streamline the permitting process for these facilities.

Onsite Wastewater Treatment Systems (OWTS)

In 2012, the SWRCB adopted an Onsite Wastewater Treatment Systems (OWTS) policy to allow continued use of OWTS while protecting water quality and public health. The use of OWTS, including septic tanks and leachfields, can be an effective means of treating and disposing of domestic wastewater in rural locations where centralized wastewater treatment systems are not available . However, there have been occasions in the state where OWTS, for various reasons, have not satisfactorily protected either water quality or public health. Some instances of these failures are related to the OWTS not being able to adequately treat and dispose of waste as a result of poor design or improper site conditions. Others have occurred where the systems are operating as designed, but their densities are such that the combined effluent resulting from multiple systems is more than can be assimilated into the environment. From these failures, California must learn how to improve usage of OWTS and prevent such failures from happening again.

As California's population continues to grow, and there are both increased rural housing densities and the building of residences and other structures in more varied terrain than ever before, there are increased risks of causing environmental damage and creating public health risks from the use of OWTS. What may have been effective in the past may not continue to be effective as conditions and circumstances surrounding particular locations change. So necessarily, more scrutiny of OWTS installation is demanded from all those involved while maintaining an appropriate balance of only the necessary requirements so that the use of OWTS remains viable.

Wastewater Infrastructure Needs

While great strides have been made in providing treatment of wastewater before being discharged to surface waters, much of the wastewater treatment infrastructure has exceeded its useful life expectancy. Without continued upgrade and replacement, the failure rates of wastewater treatment facilities could increase, thereby degrading the surface waters that receive the effluent from these facilities.

Because climate change predicts changes in streamflow patterns, the historic assimilative capacity of streams with respect to wastewater discharges would need to be re-evaluated. Treatment processes may need to be upgraded to more advanced levels. In addition, advances in knowledge of the impacts of emerging contaminants may necessitate more implementation of more advanced treatment processes.

Recommendations

1. Pollution prevention and management of water quality impairments should be based on a watershed approach. A watershed-based approach adds value, reduces cost, promotes cross-media, and integrates programmatic and regional strategies.
2. The Department of Water Resources should collaborate with the SWRCB to integrate the basin plans and other statewide water quality control plans and policies into a comprehensive water quality element of the California Water Plan.
3. The California Water Quality Monitoring Council should include a focus on emerging, unregulated contaminants in order to provide an early warning system of future water quality problems, as well as identify trends in water quality using multiple indicators of health. Drinking water supplies should have outcome-based monitoring, such as biomonitoring and waterborne disease outbreak surveillance. The proposed Interagency Water Quality Program would be

modeled after the existing Interagency Ecological Program. The groundwater portion of this effort should be consistent with the recommendations of the Groundwater Quality Monitoring Act of 2001 and DWR Bulletin 118, while the surface water aspects should be coordinated with the SWRCB's Surface Water Ambient Monitoring Program.

4. Regional, tribal, and local governments and agencies should establish drinking water source and wellhead protection programs to shield drinking water sources and groundwater recharge areas from contamination. These source protection programs should be incorporated into local land use plans and policies.

Pollution Prevention in the California Water Plan

This is a new heading for Update 2013. If necessary, this section will discuss the ways the resource management strategy is treated in this chapter, in the regional reports and in the sustainability indicators. If the three mentions are not consistent, the reason for the conflict will be discussed (i.e., the regional reports are emphasizing a different aspect of the strategy). If the three mentions are consistent with each other (or if the strategy is not discussed in the rest of Update 2013), there is no need for this section to appear.]

References

References Cited

Central Valley Regional Water Quality Control Board. 2012a. *Central Valley Regional Water Quality Control Board. Order R5-2012-0116. Waste Discharge Requirements General Order for Growers within the Eastern San Joaquin River Watershed that are Members of the Third-Party Group*. Fresno (CA): Central Valley Regional Water Quality Control Board. 184 pp. Viewed online at: http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2012-0116.pdf.

Harter T, Lund JR, Darby J, Fogg GE, Howitt R, Jessoe KK, Pettygrove GS, Quinn JF, Viers JH, Boyle DB, Canada HE, DeLaMora N, Dzurella KN, Fryjoff-Hung A, Hollander AD, Honeycutt KL, Jenkins MW, Jensen VB, King AM, Kourakos G, Liptzin D, Lopez EM, Mayzelle MM, McNally A, Medellin-Azuara J, Rosenstock TS. 2012. *Addressing Nitrate in California's Drinking Water with a Focus on Tulare Lake Basin and Salinas Valley Groundwater*. Davis (CA): Prepared for: the State Water Resources Control Board SBX2 1 Report to the Legislature. Center for Watershed Sciences, University of California, Davis. 78 pp. Viewed online at: http://groundwaternitrate.ucdavis.edu.

Heal the Bay. 2009. "Beach Report Card." Santa Monica (CA): Heal the Bay. [Web site.] Viewed online at: http://www.healthebay.org/brcv2/. Accessed: Dec., 2009.

Ode PR, Kincaid TM, Fleming T, Rehn AC. 2011. *Ecological Condition Assessments of California's Perennial Wadeable Streams: Highlights from the Surface Water Ambient Monitoring Program's Perennial Streams Assessment (PSA) (2000-2007). A collaboration between the State Water Resources Control Board's Non-Point Source Pollution Control Program (NPS Program),* *Surface Water Ambient Monitoring Program (SWAMP), California Department of Fish and Game Aquatic Bioassessment Laboratory, and the U.S. Environmental Protection Agency*. Sacramento (CA): 104 pp. Viewed online at: http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/reports/psa_smmry_rpt.pdf.

State Water Resources Control Board. 2001. Clean Beaches Initiative Grant Program. State Water Resources Control Board. [Web site.] Viewed online at: http://www.swrcb.ca.gov/water_issues/programs/beaches/cbi_projects/index.shtml.

———. 2009a.Total Maximum Daily Load Program, Section 303 (d) Policy Development. Sacramento (CA): State Water Resources Control Board. [Web site.] Viewed online at: http://www.waterboards.ca.gov/water_issues/programs/tmdl/303d_listing.shtml. Accessed: Dec., 2009.

———. 2012a. Total Maximum Daily Load Program, California's 2009 Clean Water Act Section 303(d) List of Water Quality Limited Segments. Sacramento (CA): State Water Resources Control Board. [Web site.] Viewed online at: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml. Accessed May, 2012.

———. 2013. *Communities that Rely on Contaminated Groundwater. Report to the Legislature*. Sacramento (CA): State Water Resources Control Board. 181 pp. Viewed online at http://www.waterboards.ca.gov/water_issues/programs/gama/ab2222/docs/ab2222.pdf.

U.S. Environmental Protection Agency. 2009a. *National Water Quality Inventory: Report to Congress 2004 Reporting Cycle.* Washington (DC): U.S Environmental Protection Agency. EPA 841-R-08-001. 43 pp. Viewed online at: http://water.epa.gov/lawsregs/guidance/cwa/305b/upload/2009_01_22_305b_2004report_2004_305Breport.pdf.

———. 2009b. "Clean Watersheds Needs Survey (CWNS)." Washington (DC): U.S. Environmental Protection Agency. [Web site.] Viewed online at: http://www.epa.gov/cwns. Accessed: Dec., 2009.

———. 2012. "Water: Source Water Protection." Washington (DC):U.S. Environmental Protection Agency. [Web site.] Viewed online at: http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/basicinformation.cfm.

Additional References

CALFED Bay-Delta Program. 2000. "Water Quality Program." Sacramento (CA): CALFED Bay-Delta Program. [Web site.] Viewed online at: http://www.calwater.ca.gov/calfed/objectives/Water_Quality.html. Accessed: Nov. 16, 2009.

California Coastal Commission. 2009a. Sacramento (CA): California Coastal Commission. [Web site.] Viewed online at: http://www.coastal.ca.gov. Accessed: Nov. 16, 2009.

———. 2009b. “Water Quality Program Statewide Nonpoint Source (NPS) Program Information.” Sacramento (CA). California Coastal Commission. [Web site.] Viewed online at: http://www.coastal.ca.gov/nps/npsndx.html#NPS. Accessed: Dec., 2009.

———. 2009c. “Water Quality Program Interagency Coordinating Committee.” Sacramento (CA). California Coastal Commission. [Web site.] Viewed online at: http://www.coastal.ca.gov/nps/iacc.html. Accessed: Dec., 2009.

California Department of Public Health. 2009. “Chemical contaminants in drinking water.” Sacramento (CA): California Department of Public Health. [Web site.] Viewed online at: http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Chemicalcontaminants.aspx. Accessed: Dec., 2009.

———. 2007. “Drinking Water Source Assessment and Protection (DWSAP) Program.” Sacramento (CA): California Department of Public Health. [Web site.] Viewed online at: http://www.cdph.ca.gov/certlic/drinkingwater/Pages/DWSAP.aspx.

California Department of Water Resources. 2003. *California’s Groundwater*. Sacramento (CA): California Department of Water Resources. Bulletin 118 Update 2003. 265 pp. Viewed online at: http://www.groundwater.water.ca.gov/bulletin118/update2003/.

California Water and Land Use Partnership (CA WALUP). 2009. [Web site.] Viewed online at: http://cawalup.urbanocean.org/index.php?title=Main_Page. Accessed: Dec., 2009.

California Water Quality Monitoring Council. 2012. Sacramento (CA). [Web site.] Viewed online at: http://www.waterboards.ca.gov/mywaterquality/. Accessed: May, 2012.

Center for Water and Land Use. 2009. Davis (CA): University of California, Davis Extension. [Web site.] Viewed online at: http://extension.ucdavis.edu/unit/center_for_water_and_land_use/. Accessed: Dec., 2009.

Central Coast Regional Water Quality Control Board. 2009a. “Agricultural Regulatory Program.” San Luis Obispo (CA): Central Coast Regional Water Quality Control Board. [Web site.] Viewed online at: http://www.swrcb.ca.gov/rwqcb3/water_issues/programs/ag_waivers/index.shtml. Accessed: Nov. 16, 2009.

———. “Ambient Monitoring Program (CCAMP).” 2009b. San Luis Obispo (CA): Central Coast Regional Water Quality Control Board. [Web site.] Viewed online at: http://www.ccamp.org/. Accessed: Nov. 16, 2009.

———. 2009c. “E. coli, Food Safety, and Water Quality Issues.” San Luis Obispo (CA): Central Coast Regional Water Quality Control Board. [Web site.] Viewed online at: http://www.swrcb.ca.gov/rwqcb3/water_issues/programs/ag_waivers/food_safety.shtml. Accessed: Nov. 16, 2009.

Central Valley Regional Water Quality Control Board. 2009. "Irrigated Lands Regulatory Program (ILRP)." Fresno (CA): Central Valley Regional Water Quality Control Board. [Web site.]. Viewed online at: http://www.swrcb.ca.gov/rwqcb5/water_issues/irrigated_lands/. Accessed: Nov. 16, 2009.

———. 2012b. "Drinking Water Policy." Fresno (CA): Central Valley Regional Water Quality Control Board. [Web site.] Viewed online at: http://www.waterboards.ca.gov/rwqcb5/water_issues/drinking_water_policy/. Accessed: Nov. 30, 2012.

Colorado River Basin Regional Water Quality Control Board. 2009. "Basin Plan Prohibitions and TMDLs for Agricultural Discharges." Palm Desert (CA): [Web site.] Viewed online at: http://www.swrcb.ca.gov/coloradoriver/public_notices/. Accessed: Nov. 16, 2009.

Office of Environmental Health Hazard Assessment. 2007. "Development of a Set of Impervious Surface Coefficients: A Tool for Watershed Analysis" (updated: Jan. 30, 2007). Sacramento (CA): Office of Environmental Health Hazard Assessment. California Environmental Protection Agency. [Web site.] Viewed online at: http://www.oehha.ca.gov/ecotox/isc031006.html. Accessed: Dec., 2009.

———. 2009a. "Environmental Protection Indicators for California (EPIC)." Sacramento (CA): Office of Environmental Health Hazard Assessment. California Environmental Protection Agency. [Web site.] Viewed online at: http://oehha.ca.gov/multimedia/epic/aboutepic.html. Accessed: Nov. 16, 2009.

———. 2009b. "Safe Eating Guidelines." Sacramento (CA): Office of Environmental Health Hazard Assessment. California Environmental Protection Agency. [Web site.] Viewed online at: http://www.oehha.ca.gov/fish/so_cal/index.html. Accessed: Dec., 2009.

Klasing S, Brodberg R. 2008. *Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene*. Sacramento (CA): Office of Environmental Health Hazard Assessment. California Environmental Protection Agency. 122 pp. Viewed online at: http://www.oehha.ca.gov/fish/gtlsv/pdf/FCGsATLs27June2008.pdf.

Los Angeles Regional Water Quality Control Board. 2009. "Waivers of Waste Discharge Requirements" Los Angeles (CA): Los Angeles Regional Water Quality Control Board. [Web site.] Viewed online at: http://www.swrcb.ca.gov/rwqcb4/water_issues/programs/tmdl/waivers/index.shtml. Accessed: Nov. 16, 2009.

National NEMO Network. 2009. Haddam (CT): University of Connecticut. Middlesex Cooperative Extension Center. [Web site.] Viewed online at: http://nemonet.uconn.edu/. Accessed: Dec., 2009.

National Ocean Economics Program. 2009. Monterey (CA): [Web site.] Viewed online at: http://www.oceaneconomics.org/. Accessed: Dec., 2009.

State Water Resources Control Board. 1999. "Surface Water Ambient Monitoring Program (SWAMP). AB 982. Water Code, sections 13191 and 13192." Sacramento (CA): State Water Resources Control Board. [Web site.] Viewed online at: http://www.waterboards.ca.gov/water_issues/programs/swamp/.

———. 2000. V*olume 1. Nonpoint Source Program Strategy and Implementation Plan (1998-2013).* Sacramento (CA): State Water Resources Control Board. California Environmental Protection Agency. California Coastal Commission. Viewed online at: http://www.waterboards.ca.gov/water_issues/programs/nps/protecting.shtml.

———. 2003a. *A Comprehensive Groundwater Quality Monitoring Program for California. Report to the Governor and Legislature*. Sacramento (CA): State Water Resources Control Board. 121 pp. Viewed online at: http://www.waterboards.ca.gov/gama/docs/final_ab_599_rpt_to_legis_7_31_03.pdf.

———. 2003b. *2002 CWA Section 305(b) Report.* Sacramento (CA): State Water Resources Control Board. Total Maximum Daily Load Program. 168 pp. Viewed online at: http://www.swrcb.ca.gov/water_issues/programs/tmdl/305b.shtml. Accessed: Dec., 2009.

———. 2004. *Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program.* Sacramento (CA): State Water Resources Control Board. Viewed online at: http://www.waterboards.ca.gov/water_issues/programs/nps/docs/oalfinalcopy052604.pdf.

———. 2008a. *Nonpoint Source Encyclopedia.* Sacramento (CA): State Water Resources Control Board.. Viewed online at: http://www.waterboards.ca.gov/water_issues/programs/nps/encyclopedia.shtml. Accessed: Dec., 2009.

———. 2008b. S*trategic Plan Update, 2008-2012.* Sacramento (CA): State Water Resources Control Board. Regional Water Quality Control Boards. 45 pp. Viewed online at: http://www.waterboards.ca.gov/water_issues/hot_topics/strategic_plan/docs/final_draft_strategic_plan_update_090208.pdf.

———. 2009b. "Nonpoint Source (NPS) Pollution Control Program. NPS Implementation Tools." Sacramento (CA): State Water Resources Control Board. [Web site.] Viewed online at: http://www.waterboards.ca.gov/water_issues/programs/nps/. Accessed: Dec., 2009.

———. 2009c. "Management Practices MP Miner." Sacramento (CA): State Water Resources Control Board. [Web site.] Viewed online at: http://mpminer.waterboards.ca.gov/mpminer/.

———. 2012b. GAMA – Groundwater Ambient Monitoring & Assessment Program. Sacramento (CA): State Water Resources Control Board [Web site.]. Viewed online at: http://www.waterboards.ca.gov/water_issues/programs/gama/. Accessed: May, 2012.

———.2012c. *The California Water Boards' Annual Performance Report - Fiscal Year 2010-11*. Sacramento (CA); State Water Resource Control Board. Viewed online at: http://www.waterboards.ca.gov/about_us/performance_report_1011/. Accessed: May, 2012.

U.S. Environmental Protection Agency. 2005. *Protecting Water Quality from Agricultural Runoff*. Washington (DC): U.S. Environmental Protection Agency. Nonpoint Source Control Branch. EPA 841-F-05-001. 2 pp. Viewed online at: http://www.epa.gov/owow/nps/Ag_Runoff_Fact_Sheet.pdf.

———. 2009c. “Concentrated Animal Feeding Operations – Final Rule.” Washington (DC): U.S. Environmental Protection Agency. National Pollutant Discharge Elimination System (NPDES). [Web site.] Viewed online at: http://cfpub1.epa.gov/npdes/afo/cafofinalrule.cfm. Accessed: Dec., 2009.

———. 2009d. “Animal Feeding Operations.” Washington (DC): U.S. Environmental Protection Agency. National Pollutant Discharge Elimination System (NPDES). [Web site.] Viewed online at: http://cfpub1.epa.gov/npdes/home.cfm?program_id=7. Accessed: Dec., 2009.

U.S. Geological Survey. 2009. “National Water Quality Assessment Program.” Washington (DC): U.S. Geological Survey. [Web site.] Viewed online at: http://water.usgs.gov/nawqa/. Accessed: Nov. 16, 2009.

Box 18-1 Central Coast Ambient Monitoring Program

The Central Coast Ambient Monitoring Program (CCAMP) is the Central Coast's regional component of SWAMP. CCAMP plays a key role in assessing Central Coast regional goals and has a number of program objectives: (1) assess watershed condition on a five-year rotational basis using multiple indicators of health, (2) assess long-term water quality trends at the lower ends of coastal creeks, (3) conduct periodic assessments of harbors, estuaries, lakes, and near-shore waters using multiple indicators of health, and (4) support investigations of other water quality problems including emerging contaminants, sea otter health, pathogenic disease, toxic algal blooms, and others.

Box 18-2 Central Valley Drinking Water Source Policy

Public water systems that use surface waters must comply with increasingly stringent laws and regulations designed to provide increasing protection for public health. In August 2000, the CALFED Bay-Delta Program issued a Record of Decision (ROD) requiring the California Bay-Delta Authority, with the assistance of Department of Public Health (DPH), to coordinate a comprehensive Source Water Protection Program. One element of this Source Water Protection Program is to establish a Drinking Water Policy for the Delta and upstream tributaries.

A multi-year effort is currently underway to develop a drinking water policy for surface waters in the Central Valley. As water flows out of the Sierra foothills and into the Central Valley, pollutants from a variety of urban, industrial, agricultural, and natural sources affect the quality of water, which leads to drinking water treatment challenges and potential public health concerns. Current policies and plans lack water quality objectives for several known drinking water constituents of concern, such as disinfection by-product precursors and pathogens, and do not include implementation strategies to provide effective source water protection. The types of regulatory requirements that will be included in the drinking water policy have not been determined, but the goal is to develop a policy that provides clear guidance to ensure consistent source water protection. The Central Valley Regional Water Quality Control Board has been working with a workgroup made up of interested stakeholders including federal and state agencies, drinking water agencies, and wastewater, municipal stormwater and agricultural interests, to develop a drinking water policy to help protect drinking water supplies. Additional information is available at http://www.waterboards.ca.gov/centralvalley/water_issues/drinking_water_policy/index.shtml.

Box 18-3 U.S. EPA Non-point-Source Success Stories

The U.S. EPA has highlighted a number of Non-point-source Success Stories that were identified by states as being primarily non-point-source-impaired and having achieved documented water quality improvements. These highlighted projects have received funding from Clean Water Act (CWA) section 319 and/or other funding sources dedicated to solving non-point-source impairments. The California success stories include the following water bodies:

- Big Meadow Creek and Upper Truckee River.
- Chorro Creek.
- Sacramento and Feather Rivers.
- San Diego Creek.
- San Joaquin Basin (Grasslands Watershed).
- San Joaquin River.
- Whiskeytown Lake.

These success stories are available at http://water.epa.gov/polwaste/nps/success319/index.cfm.